ME-5734

Mohawk

1200-1600

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1200-1600

HIGH SPEED DIGITAL PRINTERS

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MDS. MOHAWK DATA SCIENCES CORP.

TABLE OF CONTENTS

SECTION	PARAGRAPH	DESCRIPTION	PAGE
1		GENERAL INFORMATION	
	1.1	Introduction	1-1
	1.2	General Description	1-1
	1.3	Printer Identification	1-2
	1.4	Specifications	1-2
	1.5	Additional Specifications for the Series 1600 Printer	1-4
	1.6	Additional Specifications for the Series 1200 Printer	1-4
	1.7	Standard Equipment Supplied	1-5
	1.8	Print Drum Indexing	1-5
	1.9	Optional Features	1-10
	1.10	Interface Requirements	1-12
	1.11	Unpacking and Inspecting	1-13
	1.12	Physical Inspection	1-13
	1.13	Installation	1-13
	1.14	Storage and Reshipment	1-20
	1.15	Non-Operating Environment	1-21
	1.16	Color and Finish	1-21
2		OPERATION	
	2.1	Operating Controls and Devices	2-1
	2.2	Precautions	2-1
	2.3	Paper Loading	2-1
	2.4	Inked Ribbon Replacement	2-4
	2.5	Operator's Maintenance	2-6
	2.6	Operating Hints	2-6
3		PRINCIPLES OF OPERATION	
	3.1	Introduction	3-1
	3.2	General Theory of Operation	3-1
	3.3	Fundamental Electronic Circuits	3-3
	3.4	Logic Diagram	3-6
4		MAINTENANCE	
	4.1	Introduction	4-1
	4.2	Electronic Maintenance	4-1
	4.3	Cleaning Fan Air Filter	4-1
	4.4	Lubrication of Print Drum Drive Motor	4-1
	4.5	Changing Ribbon and Cleaning Print Drum	4-2
5		TROUBLE SHOOTING	
	5.1	Introduction	5-1
	5.2	Mechanical Malfunctions	5-1
	5.3	Electronic Malfunctions	5-8

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TABLE OF CONTENTS (Cont'd)

SECTION	PARAGRAPH	DESCRIPTION	PAGE
6		SCHEMATICS	
	6.1	Introduction	6-1
7		SPARE PARTS AND WARRANTY	
	7.1	Introduction	7-1

SCHEMATICS

RECOMMENDED SPARE PARTS LIST

WARRANTY

LIST OF ILLUSTRATIONS

FIGURE	DESCRIPTION	PAGE
1-1	Top View of Printer Chassis	1-6
1-2	Basic Printer Mechanism	1-7
1-3	Data Input Circuit	1-10
1-4	Repackaging a MDS Printer for Shipment	1-14
1-5	Dimensions of Series 1200 and 1600 Printer Mechanisms	1-16
1-5a	Dimensions of MDS Series 1200 Printer	1-17
1-5b	Dimensions of MDS Series 1600 Printer	1-17
1-6a	Series 1200 Printer BCD Pin Connections for Data and Interface	1-23
1-6b	Series 1600 Printer BCD Pin Connections for Data and Interface	1-24
2-1	Location of Operating Controls	2-3
2-2a	Paper Loading and Feed; Roll Paper	2-5
2-2b	Paper Loading and Feed; Fan Fold Paper	2-5
2-3	Inked Ribbon Loading	2-6
3-1	Simplified Diagram Showing Basic Operating Principle	3-2
3-2	Ribbon Reverse Mechanism	3-2
3-3	Basic Transistor Circuit	3-3
3-4	Flip-Flop Circuit	3-4
3-5	Monostable Multivibrator Circuit	3-5
3-6a	Logic Diagram B-1200 Printer	3-7
3-6b	Logic Diagram C-1200 & 1600 Printer	3-8
3-7a	Input Comparison Diagram-Mismatch	3-12
3-7b	Input Comparison Diagram-Coincidence	3-12
3-8	Time Sequence Chart for Type 6B Drum	3-13
4-1	Lubrication Point, Print Drum Motor	4-2
5-1	Paper Advance Mechanism Adjustment	5-3
5-2	Full Line (Timing Gear) Adjustment	5-4
5-3	Individual Column (Hammer Solenoid) Adjustment	5-7
5-4	Transistor Pin Connections (Bottom View)	5-12
6-1	H2 Schematic	6-2
6-2	H2 Assembly	6-3
6-3	J2 Schematic	6-4
6-4	J2 Assembly	6-5

TABLE OF CONTENTS (Cont'd)

FIGURE	DESCRIPTION	PAGE
6-5	H3 Schematic	6-6
6-6	H3 Assembly	6-7
6-7	J3 Schematic	6-8
6-8	J3 Assembly	6-9
6-9	Power Supply Schematic, 1200 & 1600 Printer	6-10
6-10	Power Supply Assembly, 1200 & 1600 Printer	6-11
6-11	Mechanism & Ribbon Reverse, Schematic, 1200 Printer	6-12
6-12	Mechanism & Ribbon Reverse, Schematic, 1600 Printer	6-13
6-13	Primary Wiring, 115V,& 220 VAC, 1200 & 1600 Printer	6-14

LIST OF TABLES

1-1	Model Number Identification	1-2
1-2	Standard Logic Voltage Levels	1-3
1-3	Equipment Supplied	1-8
1-4	Print Drum Designation	1-9
1-5	Available Print Drums	1-9
1-6	Input Circuit Parameters	1-11
1-7	Control Signals and Connector Pin Locations	1-22
2-1	Function of Operating Control	2-2
3-1	Truth Table of the "AND" function	3-4
3-2	Truth Table of the "OR" Function	3-4
5-1	Trouble Shooting Reference Table	5-14
6-1	Printed Circuit Card Identification	6-1
7-1	Spare Parts	7-1
7-2	Printer Supplies	7-4

SECTION 1

GENERAL INFORMATION

1.1 INTRODUCTION. This manual describes the operating procedures, the theory of operation, and the maintenance and repair instructions for both the MDS Series 1200 and 1600 Digital Printers.

These two instruments are almost identical (See Section 1-4, Specifications). The principal difference between these two printers is that one has a greater column capacity than the other (12 columns for the Series 1200 and 16 columns for the Series 1600). In this manual, however, the term "printer" will be used to describe both the Series 1200 and 1600 printers; it is important to keep in mind which particular printer is being considered when refering to this manual.

1.2 GENERAL DESCRIPTION. The MDS Printer can be used to record data from a variety of digital instruments. The printer will record on paper tape the data obtained from electronic counters, digital voltmeters, digital computers, or other devices which supply an output code for each printable character. The printer is completely self-contained and consists of the printing mechanism, power supply, and logic circuits. All electronic circuits (except the power supply) are mounted on printed-circuit cards which are keyed and color coded. The printer mechanism is mounted on slides and may be pulled forward from the main chasis for paper and ribbon loading.

The standard printing speed is 20 lines per second. However, printing speeds of 30 or 40 lines per second are available as an optional extra (See Section 1.9.1). Any number of columns of print (up to the maximum) can be selected. Input to the printer is four-wire, parallel-entry and can be either straight binary (8-4-2-1), binary-coded decimal (BCD) 4-2-2-1, or 2-4-2-1. (See Table 1-4) Decoding of the BCD inputs is described in Section 1.9.4.

The front panel controls of the printer consist of the following:

1.2.1 Paper Release Knob

1.2.2 On-Off Switch and Pilot Light

1.2.3 Paper-Out Warning Light

1.2.4 Print Once Switch

1.2.5 Standby-Print Continuous Switch

1.2.6 Operate-Inhibit Switch

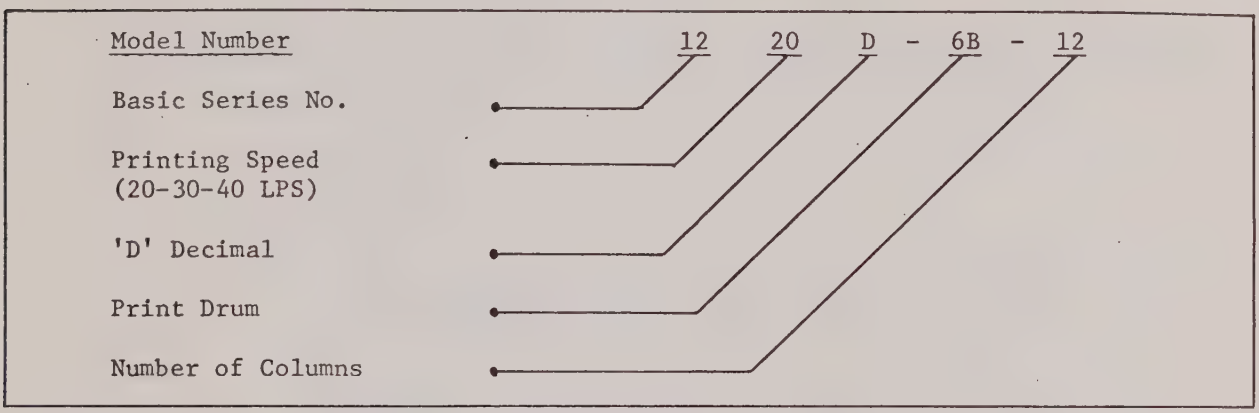
1.2.7 Paper Advance Switch

The last four functions can be controlled electronically through the rear input connector jack. (External control of the paper advance system is an optional feature; see Section 1.9.8).

The printer mechanism operates on a unique and simple principle and has only two moving parts per column of print. There is a minimum of periodic maintenance required, and the 50,000,000 lines of print warranty is considered conservative.

1.3 PRINTER IDENTIFICATION. MDS digital printers are identified by both model and serial numbers. A typical model number is generated as shown in Table 1-1.

TABLE 1-1: MODEL NUMBER IDENTIFICATION



1.4 SPECIFICATIONS. General Specifications which are applicable to both the Series 1200 and 1600 printers are as follows:

1.4.1 Speed. 20 lines per second is standard. See Optional Features Section 1.9.1 for speeds of 30 or 40 lines per second.

1.4.2 Print Cycle. Standard print cycle is 50 MS; 17 MS print time, and 33 MS idle time of which 30 MS are available for data acquisition and print command. Data to be printed must be held in parallel at input for the first 17 MS of the print cycle. If the print command is given after the specified 30 MS period, the data hold time will be extended to 67 MS. (See Figure 3-8).

1.4.3 Standard print drum characters:

a. 8421 Code: 0, 1,2,3,4,5,6,7,8,9, −, ~, Ω, +, ., *.

b. 4221 and 2421 Code: 0,1,2,3,4,5,6,7,8,9,-,*.(See Table 1-5 for a complete description of the available characters.

1.4.4 Input Logic. Input to the printer must be 4-bit binary, column parallel, and either 8421, 4221, or 2421 input code. Standard voltage levels are described in Table 1-2 and code and character selection are described in Table 1-5.

1.4.4A Operating Enviroment.
Maximum Altitude 20,000 feet
Minimum Temperature 0°C
Maximum Temperature +40° C

TABLE 1-2: STANDARD LOGIC VOLTAGE LEVELS

Condition	Standard	Optional Extra		
"0"	0V	+6V	0V	-6V
"1"	-6V	0V	+6V	0V

Input impedance for all BCD inputs above is 15K ohms. Maximum input voltage positive is +15 volts; negative is -30 volts. See Table 1-6 for non-standard logic requirements and Table 1-5 for input code and character selection.

1.4.5 Zero Suppression. Available as an optional extra in any column.

1.4.6 Printer Input Control Signals:

a. External Inhibit - This line can be used to inhibit the printer from an external source. Input impedance 15K ohms; minimum level for inhibit is negative 12V.

b. External Print Once - Printer prints once when this line is shorted to circuit ground.

c. Negative Print Command - Commands print on leading edge of negative going pulse. Maximum rise time 1 microsecond; minimum width 20 microseconds; minimum amplitude - 12 volts from a 0 volt reference.

d. Positive Print Command - Command print on leading edge of positive going pulse. Maximum rise time 1 microsecond; minimum width 20 microseconds; maximum amplitude 0 volt from a -12 volt reference.

1.4.7 Printer Output Control Signals:

a. The negative gate output is energized during the print cycle. Input data must be held in parallel while the gate is energized. Output is normally 0 volt, goes to -12 volts during printout, and back to 0 volts when printing has been completed (after 17 MS.)

b. Positive gate output is energized during the print cycle. Output is normally -12 volts; goes to 0 volts during printout, and back to -12 volts when printing has been completed (after 17 MS.)

1.4.8 Electrical Ground. Signal and chassis grounds are electrically isolated from each other; seperate connector pins are used for each. Impedance between these points is greater than 1.0 megohm. The circuit ground can be floated from chassis ground by±150V.

1.4.9 Power Requirements:

a. 105-125 volts 60 cps, 4 amperes maximum.

b. 210-250 volts 60 cps, 2 amperes maximum; optional extra.

c. 50 and 400 cps available as an optional extra.

1.4.10 Print Format. 10 characters per inch across paper, 6 lines of print per inch vertical spacing.

1.4.11 Paper Stock. 2-1/4" wide roll or folded paper. (Specify choice.)

1.4.12 Front Panel Controls:

a. Paper Release Knob

b. ON/OFF Switch and Pilot Light

c. Paper-Out Warning Light

d. Print Once Switch

e. Standby Print Continuous Switch

f. Operate-Inhibit Switch

g. Paper Advance Switch

1.4.13 Size and Weight. See Figures 1-5a and 1.5b for sizes. The printer weighs 86 lbs.

1.5 ADDITIONAL SPECIFICATIONS FOR THE SERIES 1600 PRINTER

1.5.1 Column capacity - 16 columns maximum

1.5.2 Character selection - See Table 1-5

1.5.3 Inked ribbon-Silk, 10 yards long, 1-7/8" wide, see Section 2.4.

1.5.4 Input code - 8-4-2-1 standard. Other codes can be accepted by using a specially permuted internal counter. See Section 3.4.5b for additional information regarding printers with this option.

1.5.5 Printed Circuit boards. A set of replacement boards for the Series 1600 consists of one H-board and one J-board (interchangeable between the Series 1600 and Series 1200). There is not room within the printer chassis to store a set of these boards.

1.6 ADDITIONAL SPECIFICATIONS FOR THE SERIES 1200 PRINTER:

1.6.1 Column capacity - 12 columns maximum.

1.6.2 Character Selection - See Table 1-5

1.6.3 Inked ribbon-Silk, 10 yards long, 1-5/8" wide.

1.6.4 Input Code. Standard is either 8-4-2-1, 4-2-2-1, or 2-4-2-1. See Table 1-5.

1.6.5 Printed Circuit Boards. Room is provided within the Series 1200 printer for the storage of a complete set of spare circuit boards (one each of type H and J).

1.7 STANDARD EQUIPMENT SUPPLIED. The printer supplied from the factory includes the basic mechanism, the power supply, the logic circuits which are located on the J-board, and one H-board to drive every two columns of print (See Table 1-3 and Figure 1-1).

1.7.1 Basic Mechanism (See Figure 1-2). The mechanism includes the character drum, the required number of hammer-solenoid assemblies, a paper supply, paper advance mechanism and automatic ribbon-reverse mechanism. The ribbon reverse mechanism is omitted in those printers that use "action paper". (See Section 1.9.2)

The hammer-solenoid assemblies are located only in the positions specified by the user. The positions so selected determine which columns can be printed on the paper tape and which are permanently blank. It is advisable to select columns which are symmetrically located about the center line of the paper. Printing on one side of the paper for long periods of time may shorten the ribbon life and can also cause poor ribbon tracking.

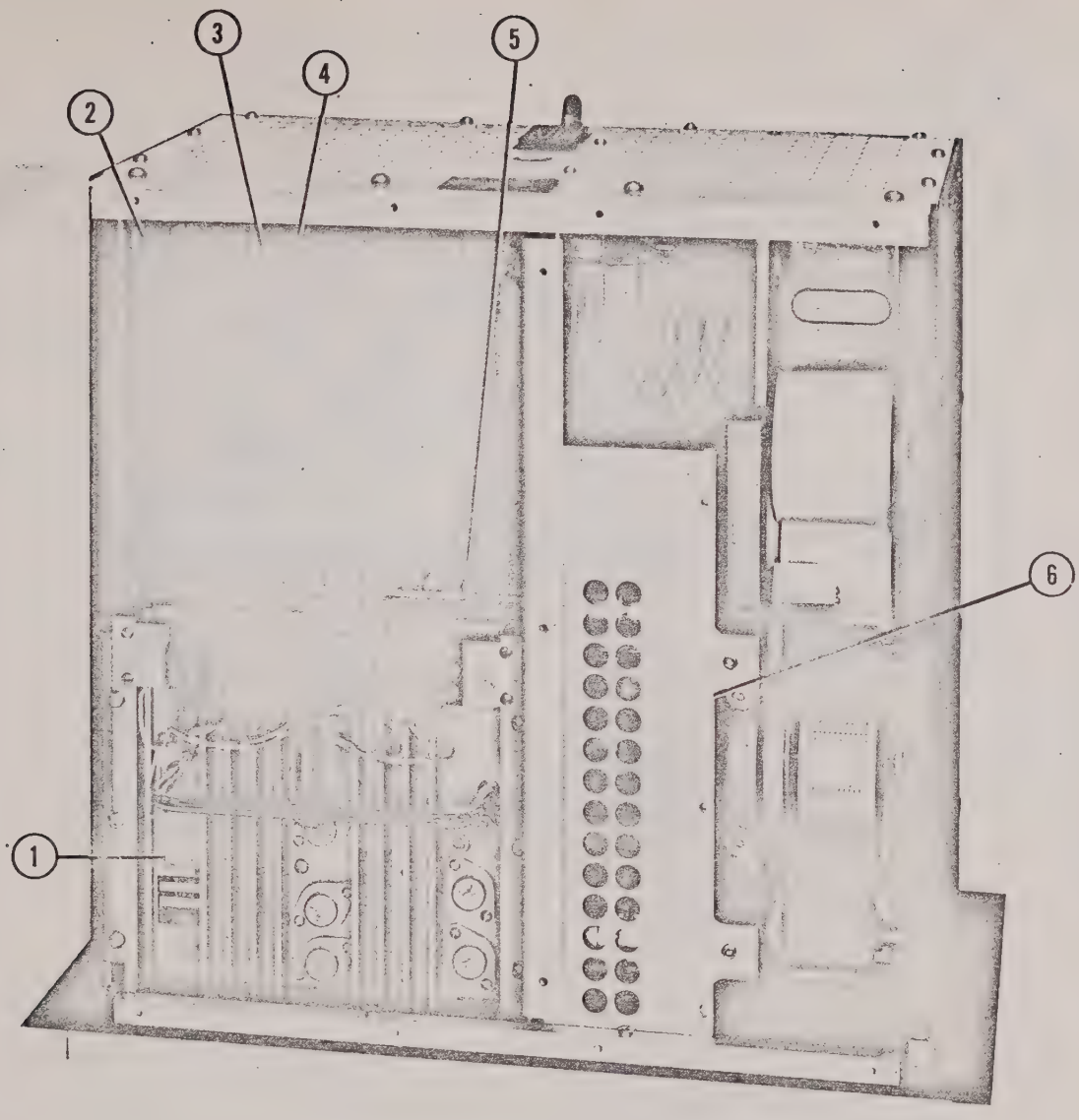
1.7.2 Power Supply. The power supply is an all-transistorized, self-contained,modular unit. It is forced-air cooled and located behind the left side of the front panel. (See Figure 1-1).

1.7.3 Electronic Complement. All of the logic and control circuits are located on a single printed circuit J-board. The column-drive circuits are located on H-boards; each H-board controls two separate columns of print. All boards are keyed and color coded. Room is provided in the Series 1200 Printer for a complete set of spare circuit boards. (See Table 1-3 and Figure 1-1).

1.7.4 Print Drum. The print drum is a cylinder. It is either 12 or 16 columns wide and has 96 equally spaced characters around its circumference. The embossed character is 0.054" wide and 0.085" high. (The actual printer character is 0.060" wide and 0.100" high). The nominal speed of rotation is 600 rpm. It will be less for 400 CPS operation.

1.8. PRINT DRUM INDEXING:

1.8.1 There are three different fonts on the 6B-12 print drum: one font accepts 8-4-2-1 straight binary input; the second mechanically decodes the 4-2-2-1 binary coded decimal (BCD) input; the third set decodes the 2-4-2-1 binary coded decimal (BCD) input. The relative position of the print drum with respect to a keyed slot on the print drum shaft determines which input will be accepted. Note : Only the 6B-12 print drum will mechanically decode BCD inputs in this way.



1. Power Supply
2. "J" Logic Control Board (1 only)
3. "H" Boards, Input Comparator and Driver Boards (6 shown for 12 columns)
4. Solenoid Driver Fuses (Located on bottom of board)
5. 2 Spaces for Spare Board Storage with Series 1200 Printers (Not available with Series 1600 Printers)
6. Printer Mechanism

FIGURE 1-1: TOP VIEW OF PRINTER CHASSIS

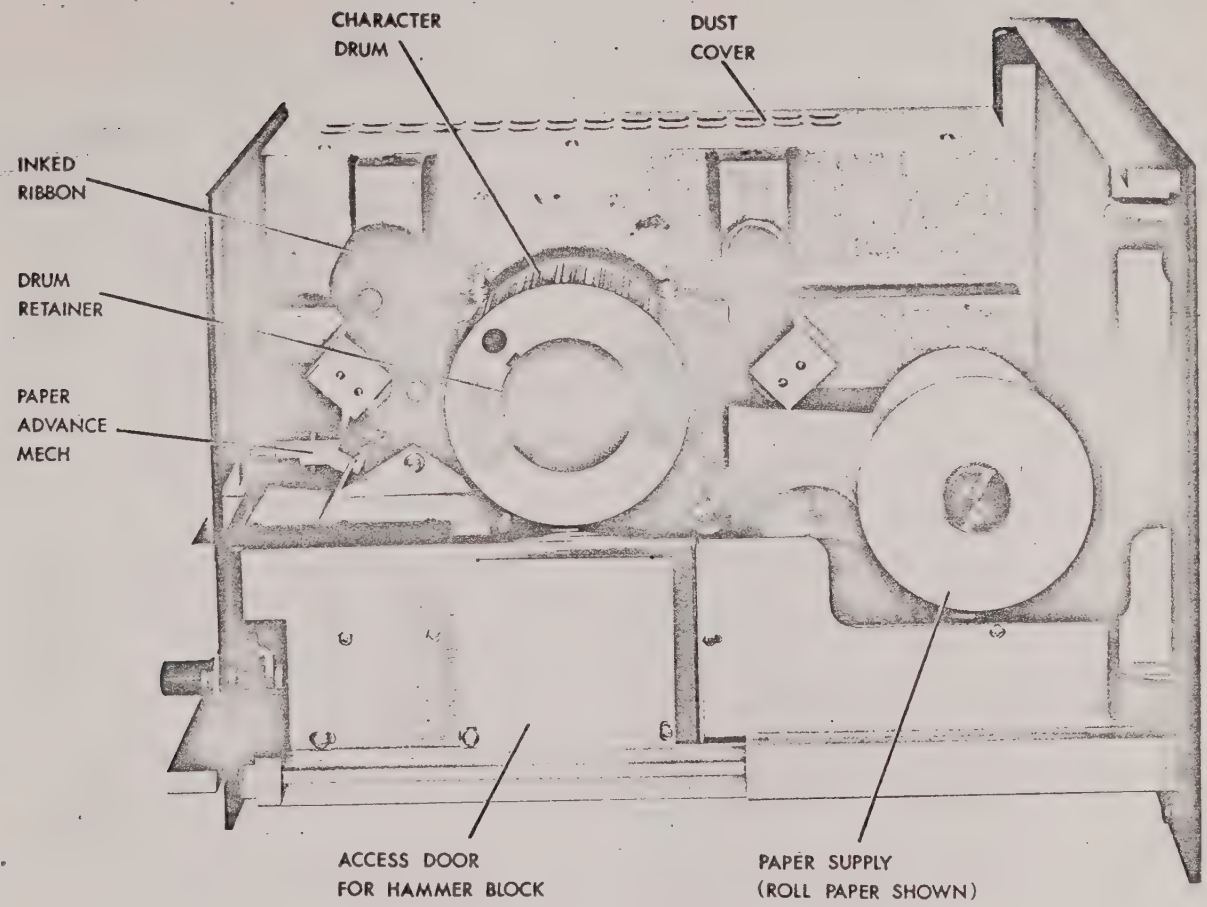


FIGURE 1-2: BASIC PRINTER MECHANISM

TABLE 1-3: EQUIPMENT SUPPLIED

Qty	Name of Unit	Part Number		Overall Dimensions	Weight
1	Digital Printer Consisting of:	Series 1200	Series 1600	(See Figure 1-5) Width - 19" Height -10-1/2" Depth - 18"	Unit Wt. -86lbs. Shipping Wt.-125 lbs
1	Printer Mechanism	PM-1200	PM 1600	Width-7-1/2" Height - 9-1/4" Depth - 16"	30 lbs. with drum
1	Power Supply	PS-1200	PS-1200	Width-8-1/2" Height-8-1/2" Depth -7-3/4"	19 lbs.
1	Enclosure with Connectors, Harness etc.	None	None	Width-19" Height-10-1/2" Depth-18"	37 lbs.
1	Standard Print Drum	6B-12	6J-16	3-5/8"Dx1-1/2"W 3-5/8"Dx1-3/4"W	4 lbs 5 lbs
1Per 2Col.	Column Driver Board	H	H	Height-9-1/4" Depth-7-1/2"	Under 1 lb.
1	Logic Board	J	J	Height-9-1/4" Depth-7-1/2"	Under 1 lb.
1	Power Cable	None	None	6 Feet Long	Under 1 lb.
1	Silk Ribbon	1200S		Length-30 Ft. Width-1-5/8"	Under 1 lb.
			1600S	Length-30ft. Width -1-7/8"	Under 1 lb.
1	Roll Paper or Fanfold Paper	1200PR 1200PF	1600PR 1600PF	Width 2-1/4"	Under 1 lb

The print drums are designed as shown in Table 1-4.

TABLE 1-4: PRINT DRUM DESIGNATION

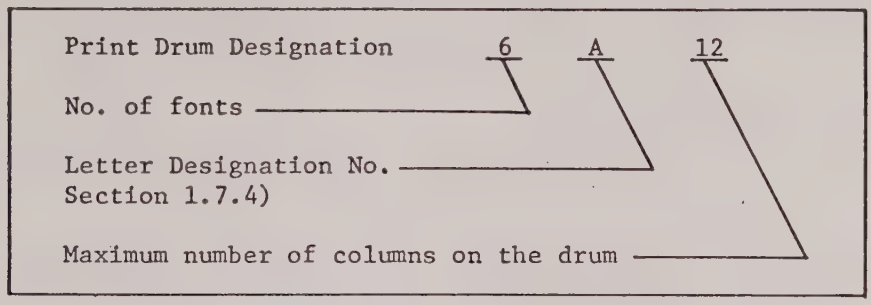


TABLE 1-5: AVAILABLE PRINT DRUMS

Input Code				Standard Character Selection			
				20 LPS		30 LPS	40 LPS
Decimal	8-4-2-1	4-2-2-1*	2-4-2-1*	6B-12*	6J-16**	6A-12 6A-16	8A-12 8A-16
0	0 0 0 0	0 0 0 0	0 0 0 0	0	0 0 0	0	0
1	0 0 0 1	0 0 0 1	0 0 0 1	1	1 1 1	1	1
2	0 0 1 0	0 0 1 0	0 0 1 0	2	2 2 2	2	2
3	0 0 1 1	0 0 1 1	0 0 1 1	3	3 3 3	3	3
4	0 1 0 0	0 1 1 0	0 1 00	4	4 4 4	4	4
5	0 1 0 1	0 1 1 1	0 1 0 1	5	5 5 5	5	5
6	0 1 1 0	1 1 0 0	0 1 1 0	6	6 6 6	6	6
7	0 1 1 1	1 1 0 1	0 1 1 1	7	7 7 7	7	7
8	1 0 0 0	1 1 1 0	1 1 1 0	8	8 8 8	8	8
9	1 0 0 1	1 1 1 1	1 1 1 1	9	9 9 9	9	9
10	1 0 1 0	1 0 0 1	1 0 0 1	-	- - .	-	.
11	1 0 1 1			~	+ ~ +	+	-
12	1 1 0 0			Ω	· Ω -	.	
13	1 1 0 1			+	Ω + A	Ω	
14	1 1 1 0			·	~ .B	~	
15	1 1 1 1	1 0 0 0	1 0 0 0	*	**C	*	

*See Section 1.8.1

**See Section 1.8.2

1.8.2 There are three different fonts on the 6J-16 print drum. All fonts accept the 8-4-2-1 straight binary input, but have a different character selection for the last 6 codes. A printer using this drum must have a permuted counter to accept any code other than the 8-4-2-1 straight binary (See Section 3.4.5b)

1.9 OPTIONAL FEATURES. In addition to the standard equipment supplied with the printer (Table 1-3),several optional features, which are also available may be specified by the user. They include the following:

1.9.1 Print Speed.(See Figure 2-5 for a typical print cycle.) The normal speed for the MDS printer is 20 LPS. This can be increased to either 30 or 40 lines per second by replacing the standard print drum with another specifically designed for that purpose. (See Table 1-5)

A. Series 1200. In order to print 30 lines per second, the 6A-12 print drum is used. To print 40 LPS the 8A-12 drum is used. In either case, the electronic circuitry has only minor changes.

B. Series 1600. In order to print 30 lines per second, the 6A-16 print drum is used. To print 40 lines per second the 8A-16drum is used. In either case the electronic circuitry has only minor changes.

1.9.2 Impact Sensitive Paper (Action Paper). The printer can be supplied with Action paper, which does not require an inked ribbon and automatic ribbon reversing mechanism. Action paper is supplied in the form of a roll. The printer speed is limited to 20 lines per second when Action paper is used.

1.9.3 Non-Standard Logic: The standard logic supplied with the MDS Printer is:
Binary "0" = 0V

Binary "1" = -6 To - 30V.

Other logic levels and polarities can be supplied as shown in Table 1-6.

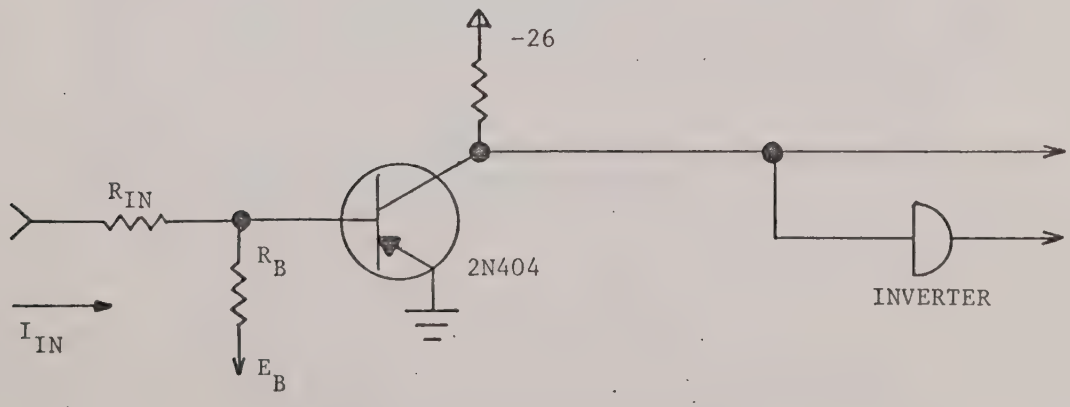


FIGURE 1-3: DATA INPUT CIRCUIT
(See Section 3.3.1 for a circuit description)

TABLE 1-6: INPUT CIRCUIT PARAMETERS

Input Logic '1' Levels *	R_{in} ($K\Omega$)	I_{in} (Min. μA)	E_B (VDC)	Notes
+3.0V (Min.)	4.7	500	-26	Logical '0'
+4.0	4.7	500		Cannot exceed +0.8V to -12V.
+5.0	10	500		
+6.0	15	400		
+7.0	15	400		
+8.0 to +15.0	15	500		
-3.0 (Min.)	6.8	400	+15	Logical '0' cannot exceed
-4.0	6.8	500		-0.8V to +12V.
-5.0	6.8	500		
-6.0	15.0	400		
-7.0	15	400		
-8.0 to -30.0	15	500		

Note: Input Logic Voltage levels other than shown can be used. Consult factory for additional information.

TABLE 1-6: INPUT CIRCUIT PARAMETERS

1.9.4 Input Codes: The counter in the MDS printers is normally designed to count in straight binary fashion, (8-4-2-1)(See Section 3.4.5). The series 1200 printer can also decode binary coded decimal (4-2-2-1, and 2-4-2-1.) This is accomplished by mechanically adjusting the 6B-12 print drum to one of three indexed positions.

These same inputs can only be decoded in the Series 1600 by permutting the internal counter. (See Section 3.4.5b).

1.9.5 50 cps Input Power. Printers supplied with this option are modified at the factory with 50 cps motors for the ribbon drive and cooling fan. However, the print-drum motor is the same as used in the 60 cps printer but has a modified pulley ratio to achieve the maximum rated printing speed. Printers supplied with the 50 cps option can also be operated with 60 cps input power, provided the timing-gear phasing is readjusted when the frequency is changed.(See Sec. 5.3.2)

CAUTION

Standard printers are built for 60 cps operation only and must not be operated with 50 cps input power.

1.9.6 400 cps Input Power. In order to avoid special 400 cps ribbon drive motors, which are expensive and difficult to obtain, this option is available only with printers that use impact sensitive 'action' paper. This paper does not require an inked ribbon. The print-drum speed of rotation is reduced from 600 RPM to 300 RPM with 400 cps power to avoid tearing the more porous 'action' paper. In order to maintain the rated print speed of 20 LPS, the 8A-12 or 8A-16 print drum must be used.

NOTE

Using an 8-font print drum will reduce the number of printable characters to 12 (Table 1-5); Print-speeds greater than 20 LPS are not available when 'action' paper is used. (For more than 12 characters a special print drum is required.)

1.9.7 RFI Requirements. Electrical interference from the printer is minimal. With a filter in the A-C power line(not supplied as standard equipment), it conforms to MIL-I 26600 (150KC-100MC radiated and conducted interference). Suitable filters are available from Filtron Co., 10023 Jefferson Blvd., Culver City, California (Model SP-223 is recommended.)

1.9.8 External Paper Advance. Provision can be made for external control of the paper advance mechanism. The paper will advance one step (without printing) each time a -6.0V pulse is received.

1.9.9 Zero Suppression. This option can be provided in all active columns and refers to the ability of the printer to detect and suppress insignificant zeros. This means that any zero without a significant digit somewhere to its left will not print. (This position is left blank.) For example the number 00704 with zero suppression will print 704.

1.9.10 Zero Suppression Inhibit. This is a feature whereby, even when zero suppression is built into the printer, insignificant zeros can be printed. This is controlled by an external signal to the printer. Application of a -6 volt minimum signal is required for zero suppression inhibit. The input resistance is 15 K ohms.

1.9.11 Character Blanking. When this option is provided, a specified character (in any particular column) will not be printed and a blank space will appear. This option can be provided in all active columns. Provisions for external character blanking inhibit can also be made for individual columns or for groups of columns.

1.10 INTERFACE REQUIREMENTS. Input to the printer is through a single rear-mounted connector. Internal circuits route this information to the desired columns and control the timing and the printing functions.

1.10.1 Data Code. Table 1-5 describes the input codes that can be used and the characters that are available with the standard print drums.

1.10.2 Print Command. The leading edge of a positive-or negative-going pulse signals the printer to print a line. The print-command pulse must have a maximum rise time 1 ms, a minimum width of 20 ms, and a minimum amplitude of 12V. The positive-going pulse should have a negative reference so that its maximum amplitude does not exceed OV. The negative-going pulse should have a reference of O V or less.

1.10.3 Inhibit Signal. The external inhibit signal voltage should be -6V with 15K ohms input impedance.

1.11 UNPACKING AND INSPECTING. The printer is shipped in a specially-constructed, protective container mounted on a wooden pallet. See Figure 1-4. Save all packing material including the pallet.

1.11.1 Cut the two bands that strap the container to the wooden pallet. Open the top of the outer container. Remove the cardboard insert and protective cushion-paper covering. Open the top of the inner cardboard container. Pull out the rear cardboard insert. Lift the printer out of the inner container. Place all packaging material back in its original position in the container, and set the packaging aside for possible future use. See paragraph 1.25 for repacking for shipment.

CAUTION

Before proceding any further, remove the hold-in-screw. This screw is for shipment purposes only and prevents the printer mechanism from sliding forward on its slide-rails. The screw is located on the back of the printer, behind the printer mechanism. It is a standard 1/4-20, slotted head screw. It is located about 1" up from the bottom of the instrument and about 5" in from the side.

1.12 PHYSICAL INSPECTION. Check the printer for any signs of physical damage such as dents, broken knobs, and similar obvious indications of improper handling. Pull the mechanism forward on its mounting slides. See caution above. It should move freely. Inspect the mechanism for any loose or broken parts.

1.12.1 Reporting Damage. If the instrument is damaged in any way, notify the carrier immediately and report the damage. Consult the warranty notice in Section 7. Request return shipping instructions from the factory.

1.13 INSTALLATION

1.13.1 Pre-installation check. Before operating the printer or connecting it to the power line, perform the following additional checks:

a. Pull the printer mechanism forward on its slide rails.

NOTE

Clearly mark the container "THIS SIDE UP" and "HANDLE WITH CARE." Shipment should be either by Rail Express or Air Express.

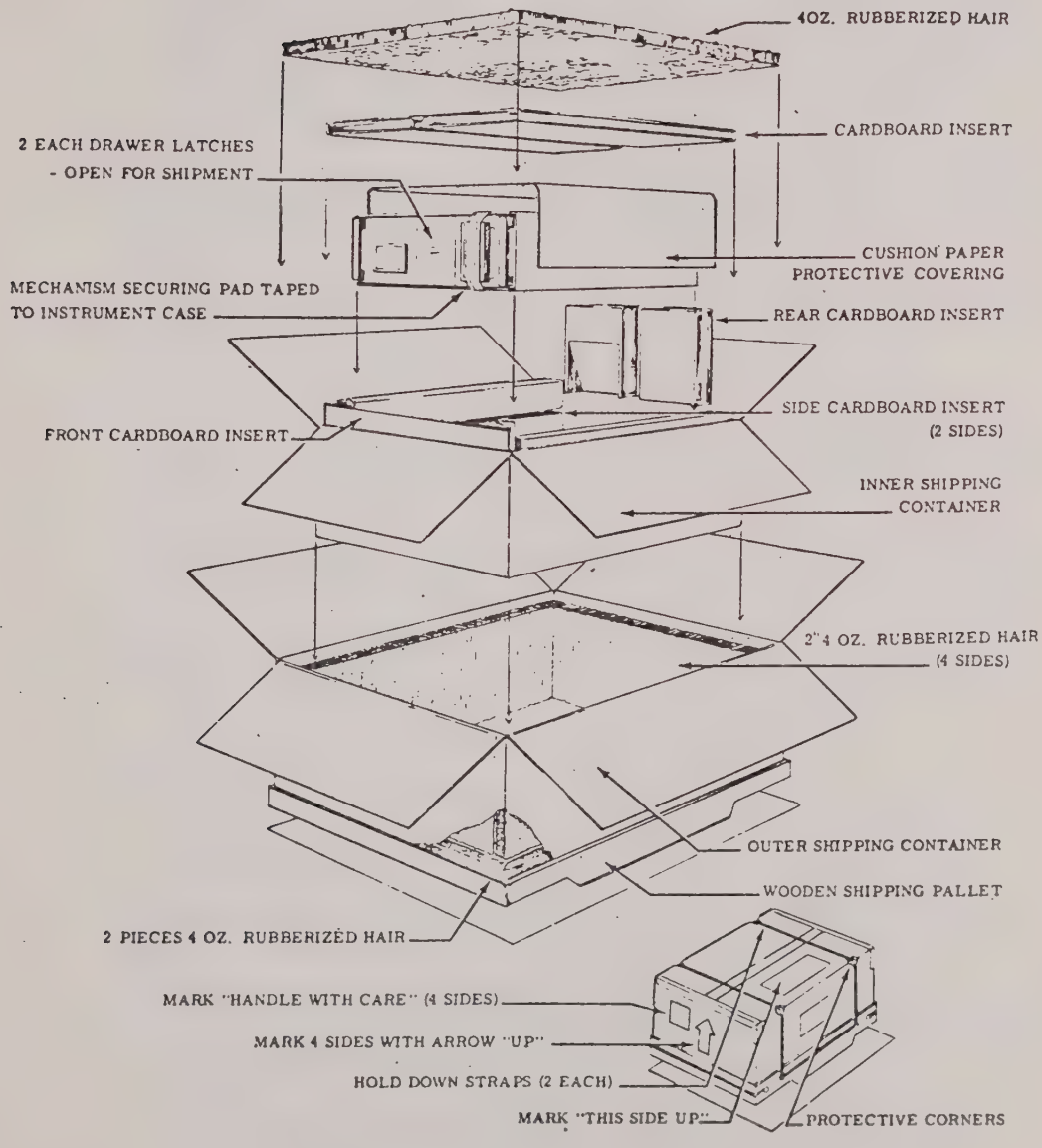

4OZ. RUBBERIZED HAIR
CARDBOARD INSERT
2 EACH DRAWER LATCHES - OPEN FOR SHIPMENT
CUSHION PAPER PROTECTIVE COVERING
MECHANISM SECURING PAD TAPED TO INSTRUMENT CASE
REAR CARDBOARD INSERT
SIDE CARDBOARD INSERT (2 SIDES)
FRONT CARDBOARD INSERT
INNER SHIPPING CONTAINER
2"4 OZ. RUBBERIZED HAIR (4 SIDES)
OUTER SHIPPING CONTAINER
WOODEN SHIPPING PALLET
2 PIECES 4 OZ. RUBBERIZED HAIR
MARK "HANDLE WITH CARE" (4 SIDES)
MARK 4 SIDES WITH ARROW "UP"
HOLD DOWN STRAPS (2 EACH)
MARK "THIS SIDE UP"
PROTECTIVE CORNERS

FIGURE 1-4: REPACKAGING AN M. D. S. PRINTER FOR SHIPMENT

b. Inspect to make sure the paper tape is properly loaded. See paragraph 2.3 for paper loading procedure. Do not continue with the following steps unless the paper is in place and properly loaded. Operation without paper may cause serious damage.

c. Inspect inked ribbon to make sure it is properly installed. Note particularly that the ribbon comes from the top of the spools, and that it passes between the rear guide pin and the actuating lever of the ribbon-reversing switch. See paragraph 2.4 for inked-ribbon installation instructions.

1.13.2 Operating precautions. Section 2 of this handbook describes all procedures and precautions. As a quick check, the following precautions should be observed during installation.

a. Make sure printer-mechanism hold-in shipping screw is removed before trying to pull printer mechanism forward.

b. Never operate the printer without paper and ribbon.

c. Never operate printer with top cover of cabinet removed. If the cover is removed, coolant air will be lost and the printer will overheat.

d. Always tear paper down against paper cutter. Never tear paper up against paper rake.

1.13.3 Initial setting of front-panel controls. Set the front-panel controls as follows :

a. STANDBY/PRINT CONTINUOUS switch to STANDBY.

b. OPERATE/INHIBIT switch to INHIBIT

c. OFF/ON switch to OFF.

1.13.4 Turning the printer on. After performing the procedures given in para. 1.14, plug the power cord into the power main.

a. With the printer mechanism still pulled forward on its slide rails, set the OFF/ON switch to ON position. Note the following indications of proper operation.

1. Green power-on indicator lights.
2. Power supply cooling fan operates
3. Print drum rotates.
4. Inked ribbon traverses from one spool to the other.

b. Press the PAPER ADVANCE switch. The paper should advance as long as the switch is pressed. Normal advance rate is 5" per second. Release the switch. It should return to the normal (up) position. Change OPERATE/INHIBIT switch to OPERATE.

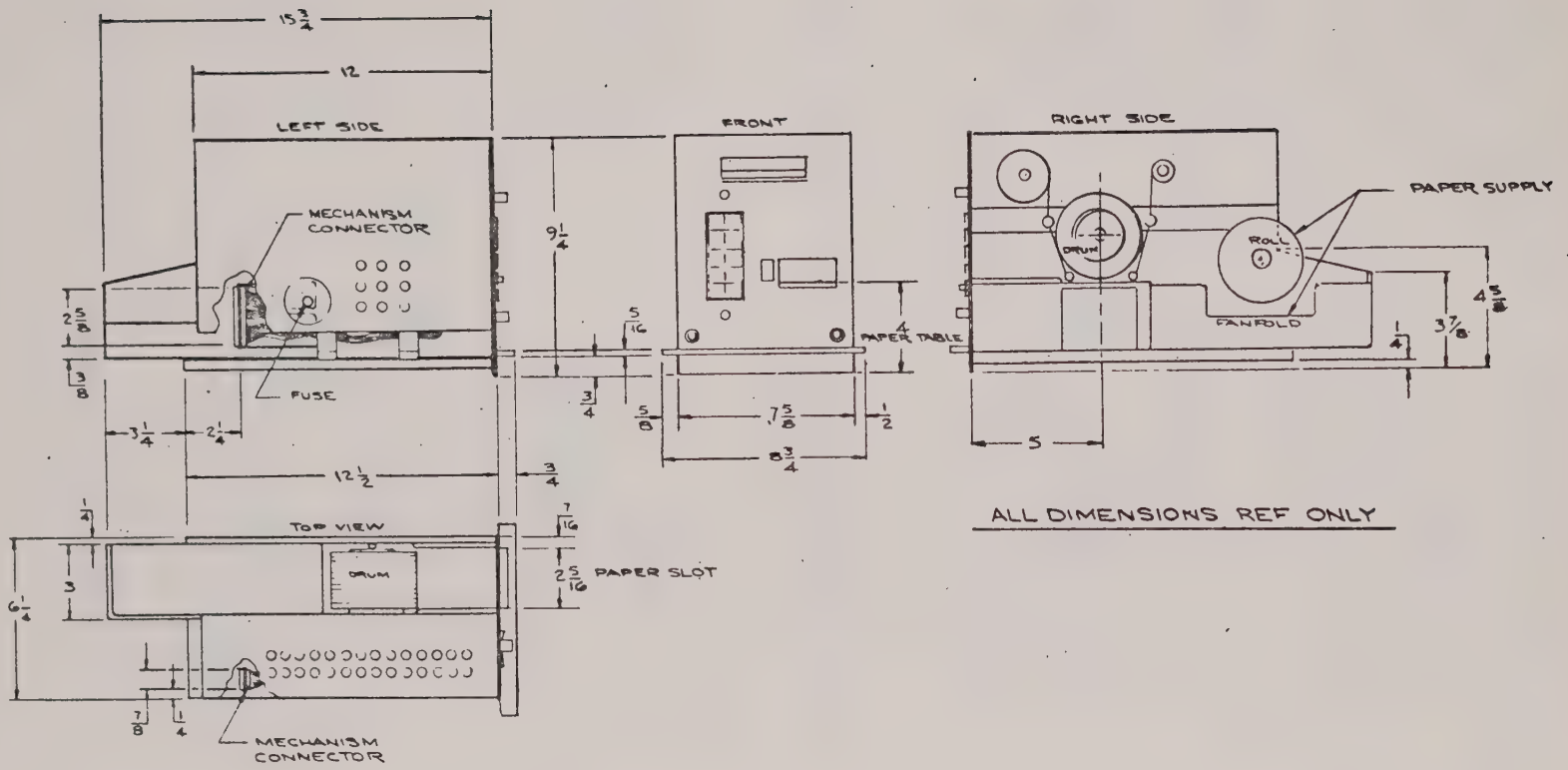


FIGURE 1-5: DIMENSIONS OF SERIES 1200 AND 1600 PRINTER MECHANISMS

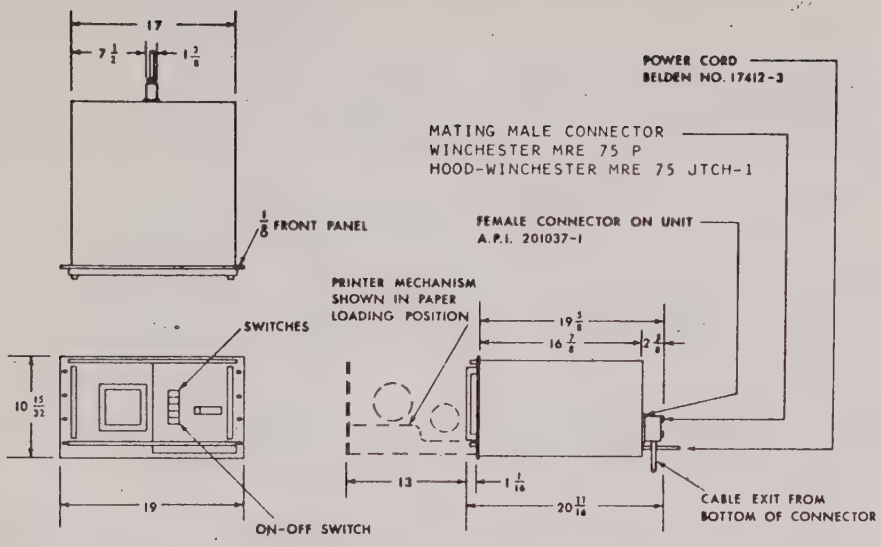


FIGURE 1-5a: DIMENSIONS OF MDS SERIES 1200 PRINTER

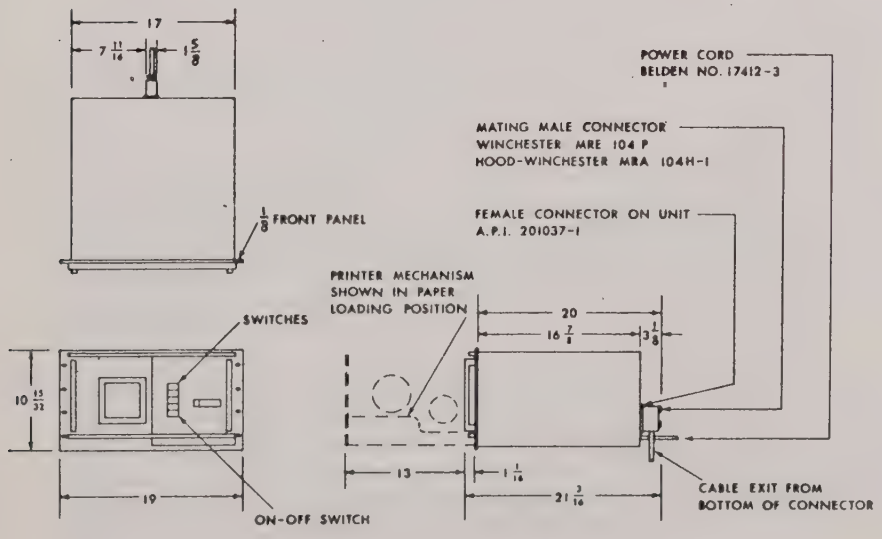


FIGURE 1-5b: DIMENSIONS OF MDS SERIES 1600 PRINTER

c. Press the PRINT ONCE switch momentarily. A line of zeros should be printed, and the paper should advance one space. (Press the PAPER ADVANCE switch to advance the paper far enough to see the line of zeros.)

d. Set the STANDBY/PRINT CONTINUOUS switch in the PRINT CONTINUOUS position. The paper should advance at the maximum print speed. Lines of zeros should be printed.

e. Remove the paper tape from the printer. The red PAPER OUT indicator should light.

f. Set the STANDBY/PRINT CONTINUOUS switch in the PRINT CONTINUOUS position. The paper should not advance nor should printing take place.

g. Observe the inked ribbon. When it reaches the end of the spool, it should reverse automatically. Reload with paper tape. See para. 2.3. The printer can now be installed.

1.13.5 Physical Installation. The printer may be mounted in a standard 19" rack or may be table mounted. The panel height requirement is 10-1/2". The depth requirement is 20-1/8" for the Model 1600 or 19-3/4" for the Model 1200. See Figures 1-5a and 1-5b.

a. Coolant air enters the printer through the front dust filter and is exhausted at the back of the printer. Make sure that hot air from other equipment does not discharge into the air intake of the printer, coolant-air exhaust will be adequate with most ventilated racks.

b. The printer may be operated in any attitude so long as paper ejection is not hindered.

1.13.6 Connecting the printer to the data source. There is one connector on the rear of the printer. All data and control connections are made at this connector. Follow standard procedures for making up a cable to carry signals to and from the printer. The connector is a standard unit, and a mating-connector is available from most suppliers of electronic components. A mating-connector can be supplied by the factory.

1.13.7 Binary coded decimal input connections. Four wires are required to carry the BCD input data to each column. Refer to Figure 1-6a or 1-6b, depending upon model, for connector pin identification. See Table 1-2 for logic levels. Refer to the identification page at the front of the manual supplied with the printer if there is any question as to which logic levels apply.

1.13.8 Control connections (Preliminary instructions). Printers of this type are essentially synchronous devices. That is, in order to print a line, various operations must occur in a definite time sequence.

a. When the printer is used to print just a few lines per second, the fact that a definite time sequence is involved, is relatively unimportant. It is simply necessary to know that:

1. The input data must be held constant for the first 17 ms of a print cycle in order to print in that cycle.

2. A print command must be given before the print cycle in which printing is to take place.

However, when it is desired to operate the printer at its maximum printing rate, synchronization with the data-collecting device is a primary requisite. Improper synchronization can limit a printer to as little as half its rated maximum printing speed.

b. A standard 20 line-per-second printer goes through 20 print cycles per second. Printing can occur during each of these cycles. But, if a print command is given after a print cycle has started, printing will not take place during that cycle. Instead, printing will occur in the next cycle. In order to print within any cycle, the print command must be given before that cycle has started.

c. A print cycle is 50 milliseconds (ms) long. During the first 17 ms, printing takes place. During the final 33 ms, the printer resets for the next cycle.

1.13.9 The first 17 ms of the print cycle. During the first 17 ms, input data, in the form of voltages representing various BCD's must be held constant at the input of the printer. It is during this time that the printer is actually printing the decimal digits represented by these BCD inputs. Any change in input data during this time, will upset the printing and result in an incorrect print-out.

1.13.10 The last 33 ms of the print cycle. During the last 33 ms of the print cycle, the input data can be removed and changed. In addition, a print command can be given, so that new input data will be recorded during the next cycle, or to be more precise, during the first 17 ms of the next cycle,

a. The print command can be given at any time during the final 33 ms. However, it is usual to give the command after the new BCD data has been entered.

1.13.11 Output signals for control. During the first 17 ms of any print cycle, when the input data must be held constant and printing takes place, a gate pulse is available for control purposes. The duration of the pulse is 17 ms. Its beginning coincides with the beginning of the print cycle; its end coincides with the end of the print portion of the cycle.

a. The gate pulse is available in both a positive and negative going form, depending upon which connector pin is used. See Table 1-7. The positive-going gate pulse has a reference of -12V and a peak of 0V. The negative-going gate pulse has a

reference of 0V and a negative peak of -12V. Either the positive-or the negative-going form of the gate pulse can be used for control purposes.

b. In the simplest form of control, the gate pulse should be applied to the inhibit input of the data-gathering device to prevent it from changing data while the printer is in the print portion of its cycle. In any installation this is perhaps the most rudimentary control. As discussed above, if only a few lines per second are required, this type of control will be adequate.

c. In the instance where the printer is to be used at its maximum line-speed, additional control provisions will be required. As described in the previous paragraph, the gate pulse will be used to keep the data-gathering device from changing its input to the printer during the first 17 ms of any print cycle. This is a requisite in most systems. In addition, the trailing edge of the gate pulse should be used to signal the data-gathering device that it has 33 ms to perform the following:

   1. Gather new data and present it to the printer.

   2. Give the printer a print command.

   Note that both operations must be performed in the 33 ms, before the start of the next cycle (before the occurrence of the leading edge of the 17 ms gate pulse signals the start of a new cycle.) If these operations are carried out in the beginning of the next cycle, printing will be delayed a full cycle.

d. Table 1-7 gives the location and description of all input and output control signals. The use of the output control signals has been discussed above. The use of the input control signals is straightforward and depends upon the users requirements. For a more detailed explanation of printer operation refer to Section 3, Theory of Operation.

1.14 STORAGE AND RESHIPMENT. To protect electronic equipment during storage or shipment, always use the best packing methods available. The factory has provided a custom designed and fabricated shipping container and wooden pallet for this purpose.

NOTE

The warranty is completely void if the printer is shipped in any packaging other than the original factory packing case and pallet. (see Section 7). A new set of packaging materials is available from the factory at a modest cost. Repackage the printer as follows: (See Figure 1-4).

1.14.1 Place the printer in the inner (smaller) container with the cardboard inserts surrounding it. If possible, wrap and seal the printer first in water-retardent paper. Then seal the inner container with paper tape.

1.14.2 Place two layers of 2" x 4 oz rubberized hair packing-pads on the bottom of the larger packing container.

1.14.3 Place the first container (and printer) in the larger container with the printer in the upright position.

1.14.4 Place the rubberized hair pads between the sides, ends and top of the two containers. Close and seal the outer of the two containers using paper tape or an equivalent sealing material.

1.14.5 Place the outer container (with the printer in the normal upright operation position) on wooden shipping pallet. Attach the shipping container to the pallet either with steel bands or permacel filament tape (or equal).

1.15 NON-OPERATING ENVIRONMENT. During storage and shipment, the environmental conditions of the printer should be limited as follows:

a. Maximum altitude: 30,000 feet.

b. Minimum Temperature - 40 degrees C (-40 degrees F).

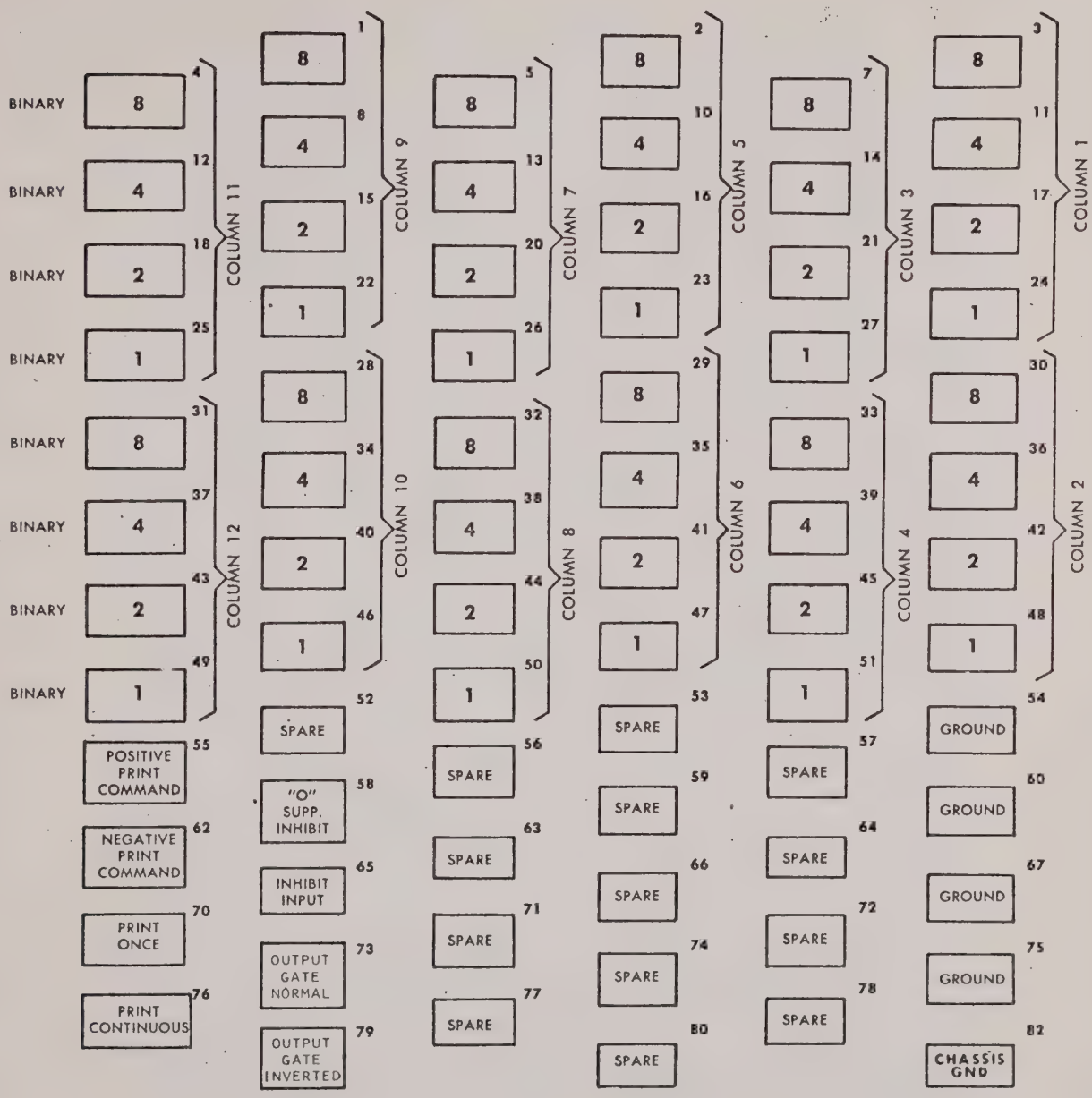
c. Maximum Temperature: +65 degrees C (150 degrees F)

1.16 COLOR AND FINISH. Standard panel color is factory specification GX71232, Dark Gray Wrinkle Finish (J.W. Rex, Lansdale, Pa.). Other paint specifications optional extra; consult the factory.

TABLE 1-7: CONTROL SIGNALS AND CONNECTOR PIN LOCATIONS

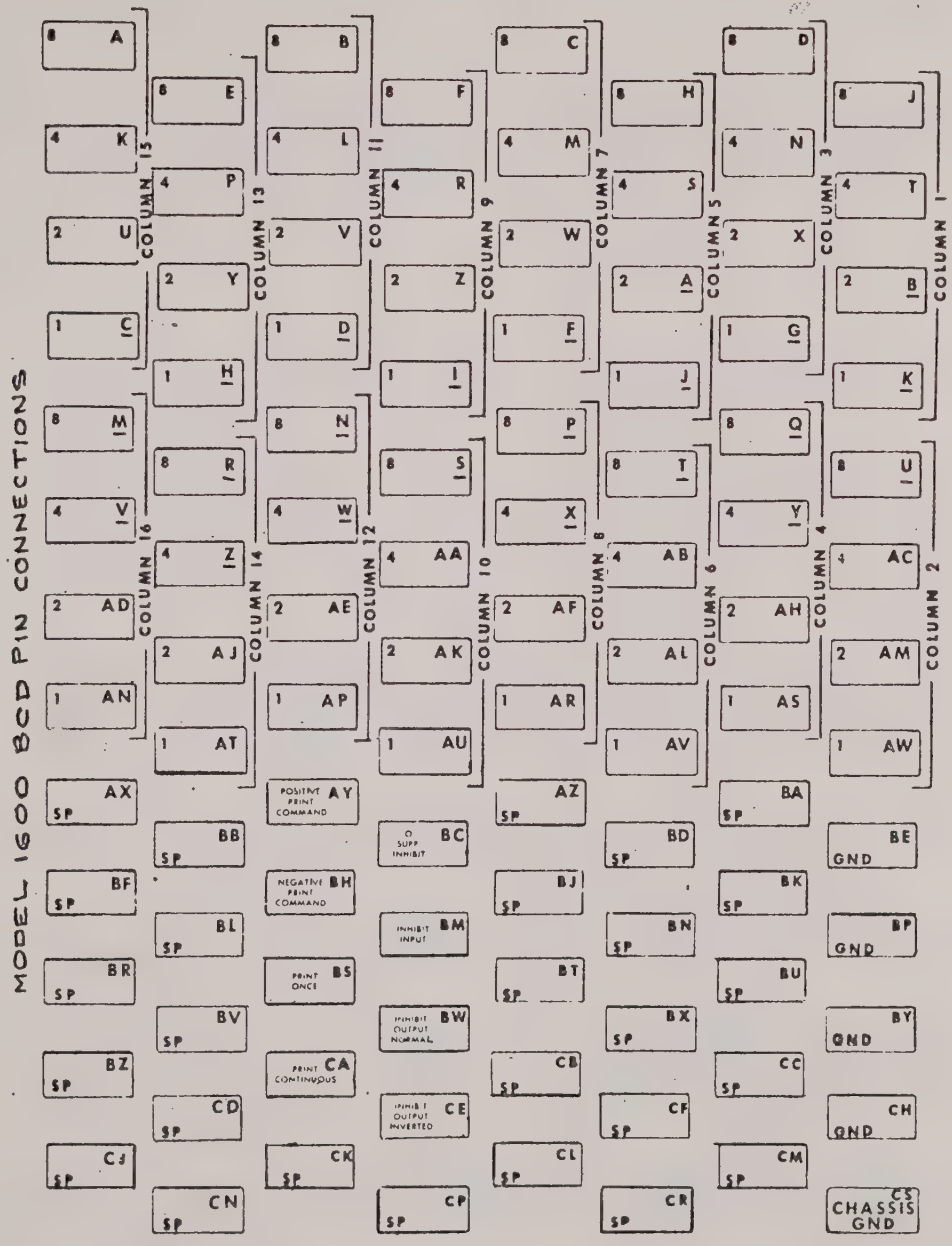
CONTROL SIGNAL	BRIEF FUNCTIONAL DESCRIPTION	PIN IDENTIFICATION	
		MODEL 1200	MODEL 1600
Positive Print Command	Input to Printer to Command one line of print. See paragraph 1.4.6d	55	AY
Negative Print Command	Input to Printer to command one line of print. See paragraph 1.4.6c	62	BH
Print Once	Input to printer to command one line of print. See paragraph 1.4.6b	70	BS
Print Continuous	Input to Printer to command continuous printing.	76	CA
Inhibit Input	Input to Printer to prevent printer from accepting a print command. See paragraph 1.4.6a	65	BM
Zero Suppression Inhibit	Input to printers equipped with zero suppression to permit printer to over-ride suppression when desired. (-12V).	58	BC
Inhibit Output Normal (Negative)	Output from printer to control data input device. See paragraph 1.4.7a	73	BW
Inhibit Output Inverted (Positive)	Output from Printer to control data input device. See paragraph 1.4.7b.	79	CE

MODEL 1200 BCD PIN CONNECTIONS



All input jacks are API connectors all mating plugs are Winchester MRE75P - supplied by the factory.

SERIES 1200 PRINTER BCD PIN CONNECTIONS FOR DATA AND INTERFACE
FIGURE 1-6a



This input jack is an API Connector mating plug Winchester MRE-104P

SERIES 1600 PRINTER BCD PIN CONNECTIONS FOR DATA AND INTERFACE
FIGURE 1-6b

SECTION II

OPERATION

2.1 OPERATING CONTROLS AND DEVICES. All operating devices and controls are located on the front panel. Figure 2-1 shows the front panel of the Model 1200. The front panel of the Model 1600 is essentially similar. Table 2-1 describes all operating devices and controls.

2.2 PRECAUTIONS. The following precautions should be observed when using the printer:

2.2.1 Paper Rake. The paper rake (Figure 1-2) will permit paper motion in one direction only. Any attempt to pull the paper tape back into the printer mechanism against this rake will damage it.

2.2.2 Paper Tear. The paper tape may be torn from the roll or pad by pulling it down against the metal tear-off edge (Figure 2-1). An upward motion of the paper tape will damage the rake. If this happens, the characters will become vertically misaligned and printed copy will be non-uniform.

2.2.3 Inked Ribbon Threading. Ribbon must be carefully threaded as described in Paragraph 2.4. Failure to do so will cause the bar at the end of the ribbon to tear out and destroy the ribbon. If it does tear out, the bar may come into contact with the print drum itself and cause irreparable damage to it.

2.2.4 Do not operate the printer without paper. The paper must be properly loaded as described in Paragraph 2.3.

2.2.5 Air Filter. The air filter on the Printer (Figure 2-1) is a metal reusable type and should be periodically cleaned (generally weekly). See Section 4.3.

2.2.6 Cooling. Never operate the printer with the top cover removed from the cabinet. With the cover removed, power supply cooling air will not circulate properly and the normal operating temperature of components may be exceeded.

2.3 PAPER LOADING. Rolled paper or fan-folded paper can be used. If rolled paper is to be used, refer to Figure 2-2a. If fan-folded paper is to be used refer to Figure 2-2b.

2.3.1 Rolled Paper Loading. To load with rolled paper, proceed as follows:

a. Turn the roll paper release screw counterclockwise until it is free of the shaft and remove.
b. Remove the spent, roll-paper spool and discard
c. Place a roll of paper on the paper-roll shaft so that the paper will feed from the bottom of the roll. Install the paper release screw.
d. Pass the paper under the rear paper guide and the anti-smear shim.

TABLE 2-1: FUNCTION OF OPERATING CONTROL

CONTROL	FUNCTION
1. Push On	This is the main power switch; push in to turn "on" or "off". The green power light is illuminated when the power is"on".
2. Paper Out Indicator	Illuminated when the printer is out of paper. The printer is automatically inhibited from printing when this indicator is lighted.
3. Paper Rake	Prevents the paper strip from moving back into the paper mechanism and maintains good column alignment.
4. Paper Tear-Off Edge	Pull paper tape down to tear paper.NOTE: If the paper tape is pulled upward, the paper rake will become permanently damaged.
5. Drawer Latches (right & left)	Two latches hold the printer mechanism in the main chassis. The mechanism, which is mounted on slides, can be moved forward by turning the latches as indicated.
6. Paper Emit Slot	Hole from which printed paper tape emits.
7. Print Once Switch	The printer prints once each time it is depressed.
8. Paper Advance Switch	When depressed the paper advances continuously at the rate of 5 inches per second.
9. Standby-Continuous Switch	This is a two position rocker switch. In the "standby" position, external print command signals (either electronic or manual) will initiate a print cycle. In the down or "continuous" position, the printer prints continuously at a maximum rated speeds from internally generated print command signals.
10. Inhibit-Operate Switch	This is a two position rocker switch that is normally in the "operate" position. In the "Inhibit" position the printer will not accept a command signal from any source (either internal or external).
11. Paper Release	Controls the idler wheel of the paper advance mechanism (Figure 2-2a). When depressed, the idler wheel rises from the driving wheel and paper can be pulled manually through the printer mechanism.
12. Air Filter	Intake vent of air flow (approximately 100 CFM).

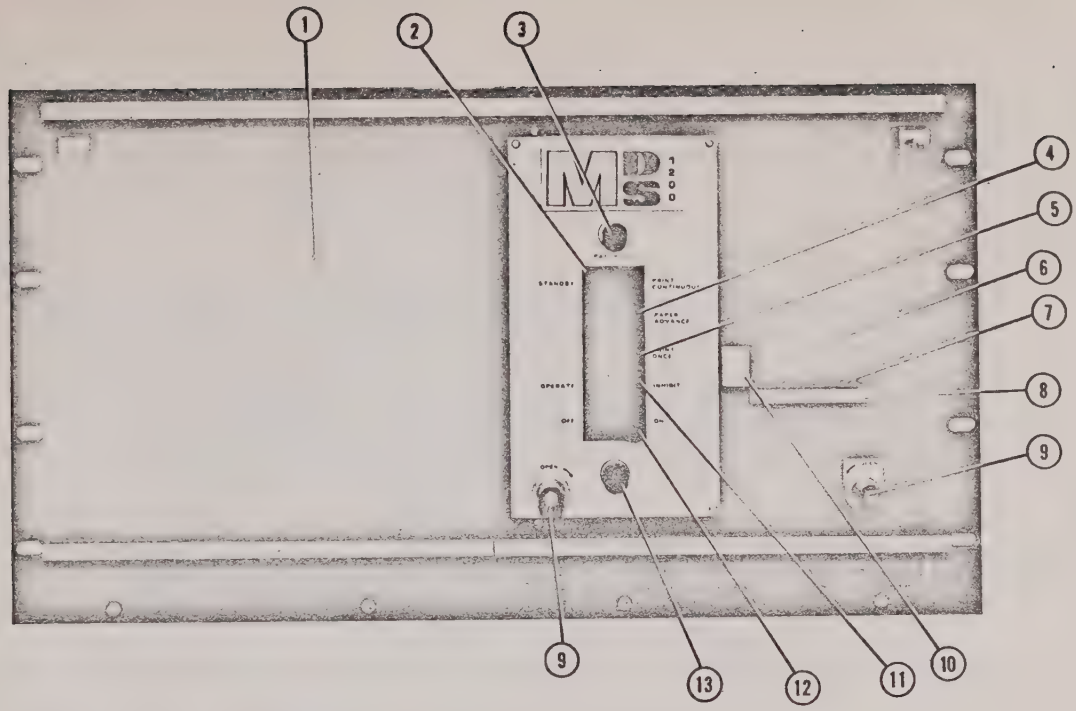


FIGURE 2-1

Location of Operating Controls

Control location is similar for 1200 and 1600 Series Printers

1. Air Filter
2. Standby - Continuous Switch
3. Paper Out Indicator
4. Paper Advance Switch
5. Print Once Switch
6. Paper Rake
7. Paper Emit Slot
8. Paper Tear-Off Edge
9. Drawer Latches (Right & Left)
10. Paper Release
11. Inhibit - Operate Switch
12. Power On-Off Switch
13. Power On Indicator

e. Hold the paper-release knob down and pass the paper under the idler wheel and paper-rake mechanism.

NOTE

Take particular care when passing the paper under the paper rake. Upward pressure against the rake should be avoided.

f. With the paper-release knob still held down, grasp the tape at the front of the printer and pull it forward a few inches, while observing the tape threading. The paper tape should move freely with almost no drag.

g. Permit the paper-release knob to return to its normal up-position and slide the printer mechanism back into the cabinet. Hold the paper release knob down and repeat step f.

2.3.2 Fan-Folded Paper Loading. To load fan-folded paper proceed as follows:

a. Place a pack of fan-folded paper in the tray.

b. Pass the paper, from the top of the pack, through the mechanism as described for rolled-paper loading.

If the printer has been used with rolled-paper tape, it will be necessary to first remove the paper-roll spindle and the rolled-paper tension spring before proceeding. It may also be necessary to readjust the tension of the paper rake when changing from rolled to fan folded paper. See Paragraph 5.2.1c.

2.3.3 Impact-Sensitive Paper Loading. Impact-sensitive paper (action paper) is specially treated so that it develops an image at any place that it is struck. Therefore, an inked ribbon, with its associated reversing mechanism, is not required when impact-sensitive paper is used. Impact-sensitive paper is supplied in rolls only. Printers for use with impact-sensitive paper cannot be used at speeds greater than 20 lines per second. Loading is as described for ordinary paper tape. (Par. 2.3.1)

2.4 INKED RIBBON REPLACEMENT. Refer to Figure 2-3 and proceed as follows:

a. Slide mechanism forward from main chassis.

b. Remove old ribbon by pulling ribbon-spools off ribbon arbor shafts. Discard the old ribbon.

c. New ribbons are supplied with two spools. Slide the new spools on the ribbon arbor shafts, leave a 10" or 12" loop of ribbon between the two spools and slide the new spools on the arbor shafts. Note that the ribbon must feed from the top of each spool.

d. Slide the ribbon under the anti-smear shim and guide pins as shown in Figure 2-3.

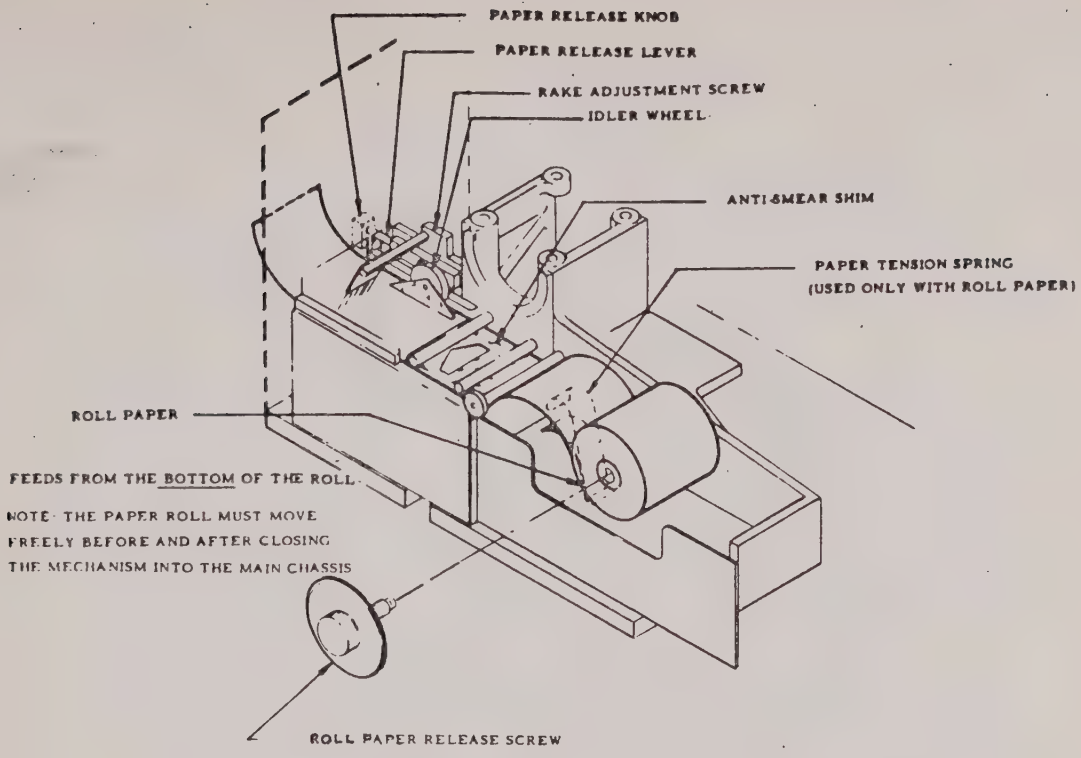


FIGURE 2-2a: PAPER LOADING AND FEED; ROLL PAPER

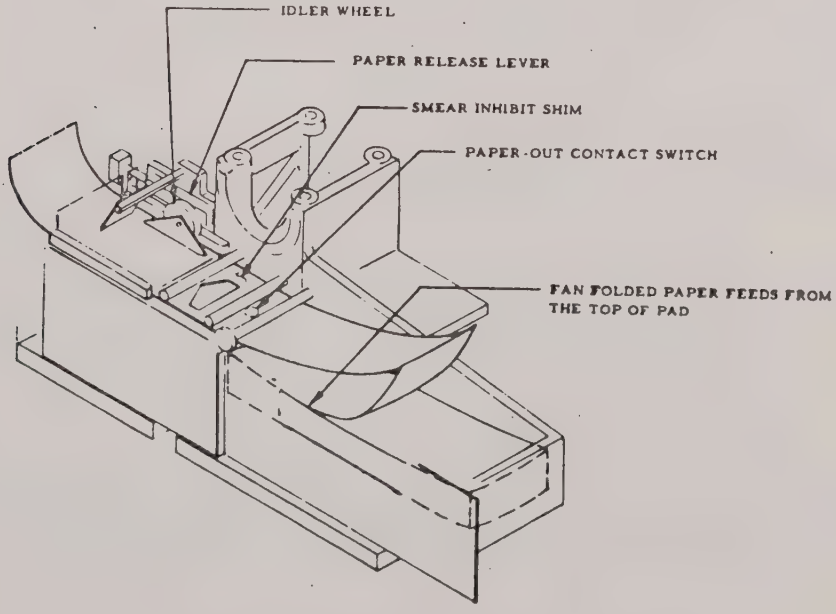


FIGURE 2-2b: PAPER LOADING AND FEED; FAN FOLD PAPER

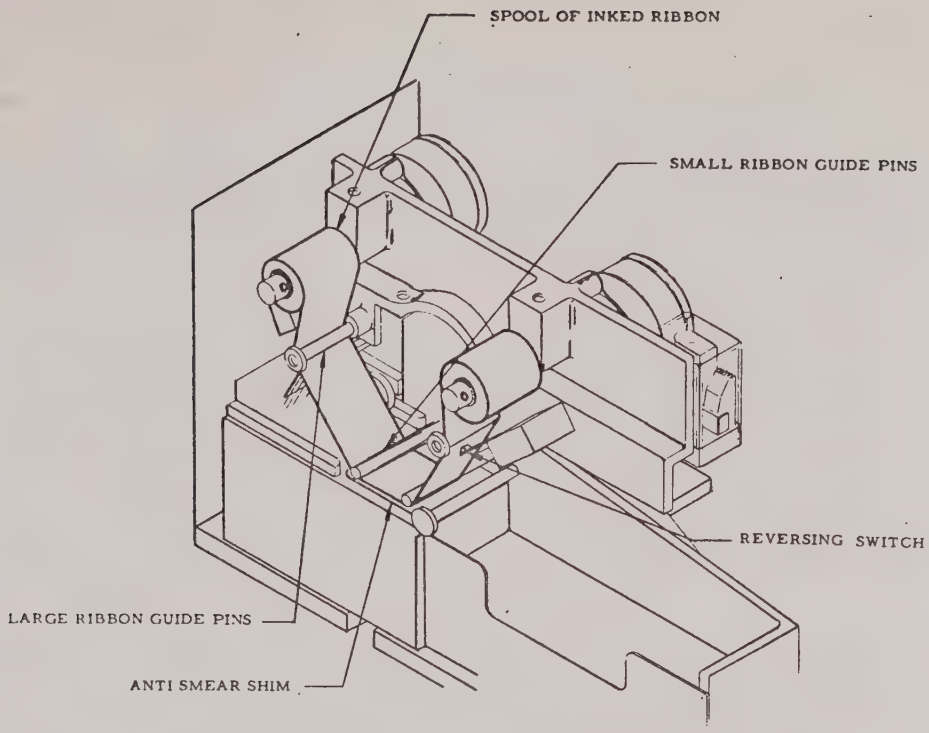


FIGURE 2-3: INKED RIBBON LOADING

CAUTION

The inked ribbon must pass between the rear, ribbon guide pin and the actuating lever of the ribbon-reversing switch. If not, the ribbon will not reverse at the end of its travel and will be damaged.

2.5 OPERATOR'S MAINTENANCE. The air-filter should be cleaned once a week under usual 40-hour a week operation. In very dusty locations, the air filter will require more frequent cleaning. A temperature rise of more than 10degrees F between the intake and exhaust air would indicate a dirty filter.

2.6 OPERATING HINTS. MDS papers and ribbons are specially selected to provide the best possible performance with the least amount of wear on the printer mechanism. Use of inferior paper and ribbon can result in excessive lint deposits, poor print quality, and excessive wear. Order replacement ribbons and paper from the factory to assure optimum performance from the printer.

SECTION 3

THEORY OF OPERATION

3.1 INTRODUCTION. This section describes the basic theory of operation of the MDS printer. It includes the logic diagram, a basic description of the individual circuit functions and a detailed description of the electronic circuits.

3.2 GENERAL THEORY OF OPERATION (Figure 3-1). All characters that can be printed are engraved on the outside surface of a constantly revolving drum. One complete set of these characters, 0 through 9 and several symbols, make up a character font; each font is repeated several times around the print drum. Beneath the drum is a number of electrically operated hammer-solenoid assemblies, one for each column of print. To print a character, each hammer is individually driven against the paper tape, inked ribbon, and character on the print drum. Because of the mass-energy relationships involved, the hammer striking speed is so rapid that printing is accomplished without blurring.

The paper is stopped during the print cycle and is automatically advanced after the completion of each printed line. The inked ribbon moves continuously, automatically reversing itself, without regard to the printing cycle.

The position of each row of characters on the print drum with relation to the hammer is precisely established by a code wheel in conjunction with a magnetic (reluctance) pick up. One "character" pulse is generated each time a row of characters is in printing position opposite the hammers. The absence of a character pulse begins the print cycle and is called a 'sync' pulse; the last character pulse ends the cycle. There are 17 pulses in the complete print cycle.

3.2.1 Hammer Solenoid Assembly. This mechanism is simple and trouble-free. The solenoid arm pivots about a stainless steel pin. Total motion is approximately .010. The hammer is made from a single block of stainless steel; it is spring retained on the solenoid tip, and has a total motion of about .040. (the last .020 of which is controlled by a screw adjustment under the solenoid tip. (Sec. 5.2.2.b)Lubrication of this assembly is not required.

3.2.2 Paper Shift Mechanism. The paper tape is pinched between a drive wheel (mounted on the shaft of an electrically operated stepping motor) and an idler wheel (Figure 2-2). The drive wheel is automatically advanced one position after each printing cycle. The paper tape moves forward about 1/6" and comes to rest before the next print cycle begins. The pressure of the idler wheel against the paper is controlled by an adjustment of the front panel release (Figure 2-1). This release must be used when reloading paper through the mechanism.

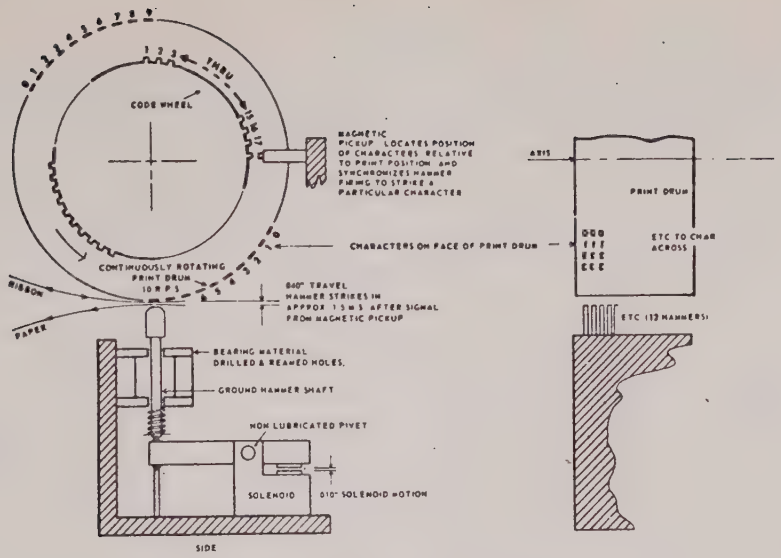
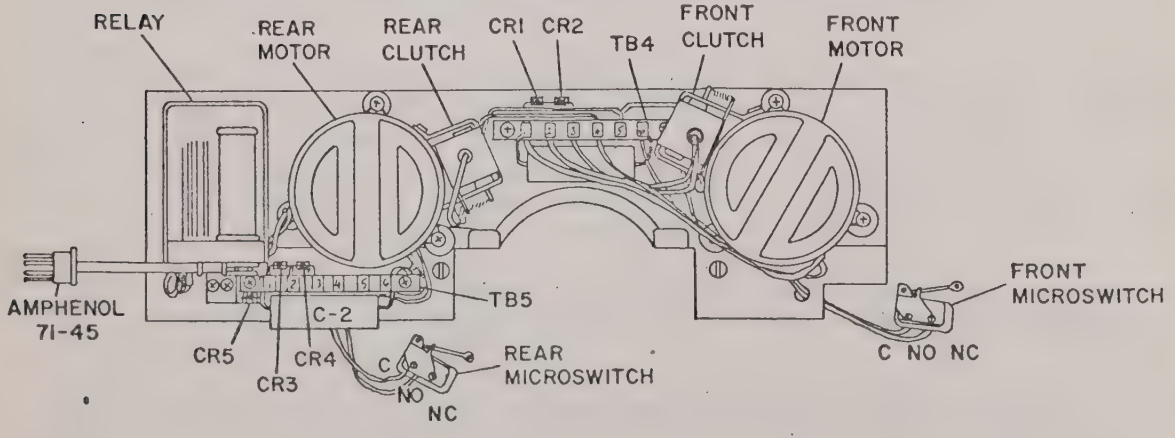

CODE WHEEL
MAGNETIC PICKUP LOCATES POSITION OF CHARACTERS RELATIVE TO PRINT POSITION AND SYNCHRONIZES HAMMER FIRING TO STRIKE A PARTICULAR CHARACTER
CONTINUOUSLY ROTATING PRINT DRUM 10 R P S
CHARACTERS ON FACE OF PRINT DRUM
PRINT DRUM
ETC TO CHAR ACROSS
ETC (132 HAMMERS)
RIBBON
PAPER
.040" TRAVEL HAMMER STRIKES IN APPROX 1.5 m s AFTER SIGNAL FROM MAGNETIC PICKUP
BEARING MATERIAL DRILLED & REAMED HOLES.
GROUND HAMMER SHAFT
NON LUBRICATED PIVOT
SOLENOID
.010" SOLENOID MOTION
SIDE

FIGURE 3-1:
SIMPLIFIED DIAGRAM SHOWING BASIC OPERATING PRINCIPLE

3.2.3 Ribbon Reverse Mechanism (Figure 3-2). The ribbon is alternately driven by two electric motors that are individually controlled by mechanical clutch assemblies. Each motor and its associated clutch is controlled by a relay; this relay is controlled by two snap-action switches.

When the ribbon reaches the end of its travel in one direction a bar on the ribbon engages the arm of one of the snap-action switches. This switch will either energize or de-energize the ribbon reverse relay. The condition of this relay determines which drive motor is operating. The direction of motion of the ribbon is then reversed. This action continues automatically as long as the main power switch is "on".



NOTE
REAR VIEW OF RIBBON REVERSE MECHANISM
REFERENCE WITH SCHEMATIC D-8215

FIGURE 3-2: RIBBON REVERSE MECHANISM

NOTE'

If this mechanism is operated without paper, the drive wheel will abrade the idler wheel and spoil the eveness of paper shift operation.

3.3 FUNDAMENTAL ELECTRONIC CIRCUITS.

3.3.1 The basic circuit used in the Printer is as follows:

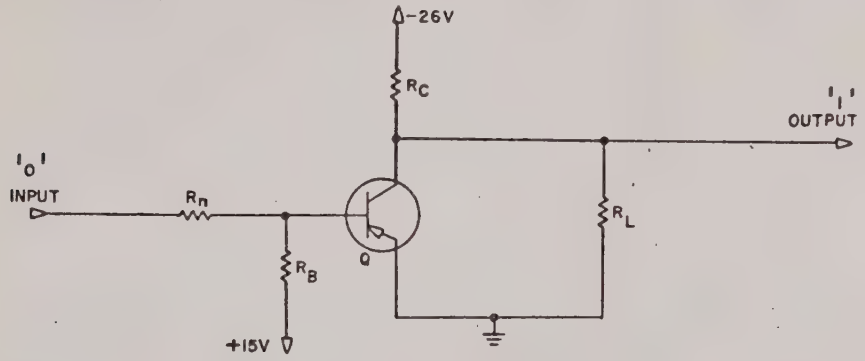


FIGURE 3-3: BASIC TRANSISTOR CIRCUIT

This is a common emitter type saturable amplifier-inverter, Q is a PNP type transistor, generally a 2N404.

R_C is the collector current limiting resistor. Its value is determined by the maximum amount of collector current desired. R_L may consist of one or more resistors, some of which may be input resistors to following stages. This value is selected so the $R_L = R_C$ R_n is the base current limiting or input resistor. When the input voltage and current, and the transistor current transfer characteristics are known, R_n can be selected to pass enough current to overcome the bias current and to completely saturate the transistor in the 'on' condition; 500 a of current is generally sufficient. R_B is the base bias resistor and its value is selected to supply enough bias current to overcome collector to base leakage, even while subjected to high ambient temperatures.

When the circuit input is logical "0" the transistor will not conduct and there will be current flow between ground and the -26V supply through R_C and R_L. The output will be known as logical "1". Conversely, when the circuit input is logical '1' which normally corresponds to a negative voltage input, the transistor will conduct and the output of the circuit will be logical '0'.

3.3.2 Inverter Circuits (7A,7B,7C,7D,7E,7F,7G,7H,7J and 5C). Inverter circuits in the MDS printers are identical with the basic transistor circuits (Figure 3-3)

3.3.3 "AND" Gates (circuits 5A,5B,5E,5F,5G and 5H). "AND" gates are multiple input circuits that require all input signals to be a logical "0" to produce a logical '1' output. Additional input resistors (R_i) do not change the basic operating principles of the circuit described in 3.3.1. The 'and' function is described in Table 3-1.

INPUT			OUTPUT
Ri	Ri	Ri	RC
1	0	0	0
0	1	0	0
0	0	1	0
0	0	0	1

TABLE 3-1: TRUTH TABLE OF THE "AND" FUNCTION

3.3.4 "OR" gates (circuits 6A). "OR" circuits are multiple input circuits that require all inputs to be logic "0" to produce a "1" output. A change of any input to "1" will cause the output to change to "0". (This is the "OR" function.) See Table 3-2.

INPUT			OUTPUT
Ri	Ri	Ri	RC
0	0	0	1
1	0	0	0
0	1	0	0
0	0	1	0

TABLE 3-2: TRUTH TABLE OF THE "OR" FUNCTION

3.3.5 Flip-Flop (Circuit 1A, 2B, 2C, 2D and 4A).

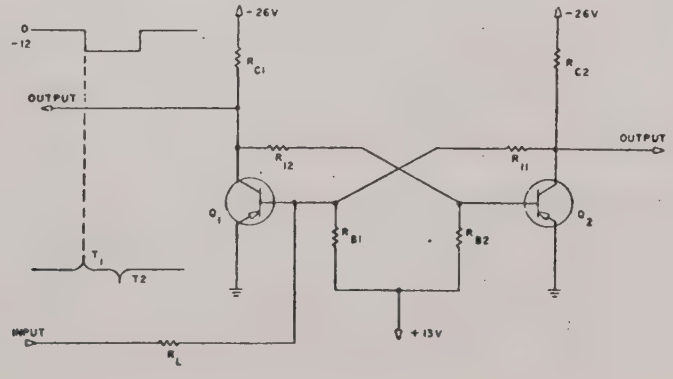


FIGURE 3-4: FLIP FLOP CIRCUIT

The basic flip-flop is a bi-stable (multivibrator) two transistor circuit, in which one transistor conducts holding the other cut off. Each input pulse causes reversal of states. In the circuit shown, Q1 is initially conducting; its collector voltage is "0" which is applied to the base of Q2 through R12; it has no effect in overcoming the positive voltage through RB2 and Q2 remains cut off. When Q2 is off, a negative voltage is developed at the junction of RC2 and R11; this voltage is sufficient to overcome the positive voltage RB1 and will supply enough current through R11 to keep Q1 saturated. At time T1, the positive pulse cuts off Q1; the collector voltage goes negative and supplies current to drive Q2 into conduction. Q2 now conducting has its collector voltage "0" and so no voltage is applied to the base of Q1 which will then remain cut off.

In a similar fashion, the negative input pulse at T2 starts a sequence of events which will result in Q1 conducting. In actual practice, the method of setting or re-setting these circuits is based on the above theory but may differ in the techniques used.

3.3.6 Monostable Multivibrator Circuit (9B).

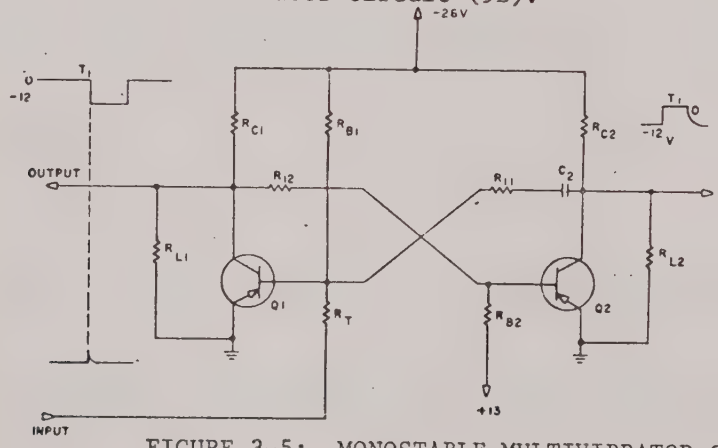


FIGURE 3-5: MONOSTABLE MULTIVIBRATOR CIRCUIT

The one shot, or monostable multivibrator, is a circuit which generates an output pulse of a specified duration when triggered by a suitable input pulse. The following conditions exist during the initial quiescent period: RB1 delivers sufficient negative voltage to the base of Q1 to hold it in saturation. The collector of Q1 is at "0" so it will not deliver any current to the base of Q2 which is held in cut off.
At time T1, the positive triggering pulse reduces conduction of Q1; resulting negative going voltage at the collector of Q1 is applied through R12 to the base of Q2 which begins to conduct; the resulting positive going change in C2 collector voltage is coupled through R11 and Q2 to the base of Q1. This continues to decrease the conduction of Q1; the entire process is regenerative and quickly results in Q1 being saturated.

Capacitor C2 now charges at a rate determined by the values RB1 and C2 (main charge path Q2 -C2 - RB1). When the base of Q1 becomes sufficiently negative, Q1 begins to conduct. The resulting positive voltage at the collector Q1 is delivered to the base of Q2. The Q2 collector voltage goes negative and is coupled through C2 and R11 to Q1 base to further Q1 conduction. This process is regenerative and ends with the circuit in the original quiescent state with Q1 and Q2 shut off.

3.4 LOGIC DIAGRAM (Figure 3-6). All of the electronic circuits (except the power supply), in the standard printers are mounted on printed circuit boards. The "J" board contains all of the logic control circuits; the "H" board contains the input circuits, the comparison circuits and the circuits required to drive the hammer solenoids. (Each "H" board controls two individual columns.)

3.4.1 Initial Conditions. In order for a print cycle to begin the following conditions must be met.

a. Paper must be under the print drum in order to remove the inhibit signal from the "paper-out" switch.

b. The "inhibit-operate" switch must be in the "operate" position; the external "inhibit" line must be open.

c. An external print command (either electronic or manual) must be given.

3.4.2 Notes on Logic Diagram (Figure 3-6).

a. The logical levels ('0' and '1') indicated on the circuit elements are the quiscent state before the print cycle begins.

b. The logical '0' state describes the associated transistor to be in saturation which results in 0 V output; the logical '1' state represents a negative voltage, usually -12V.

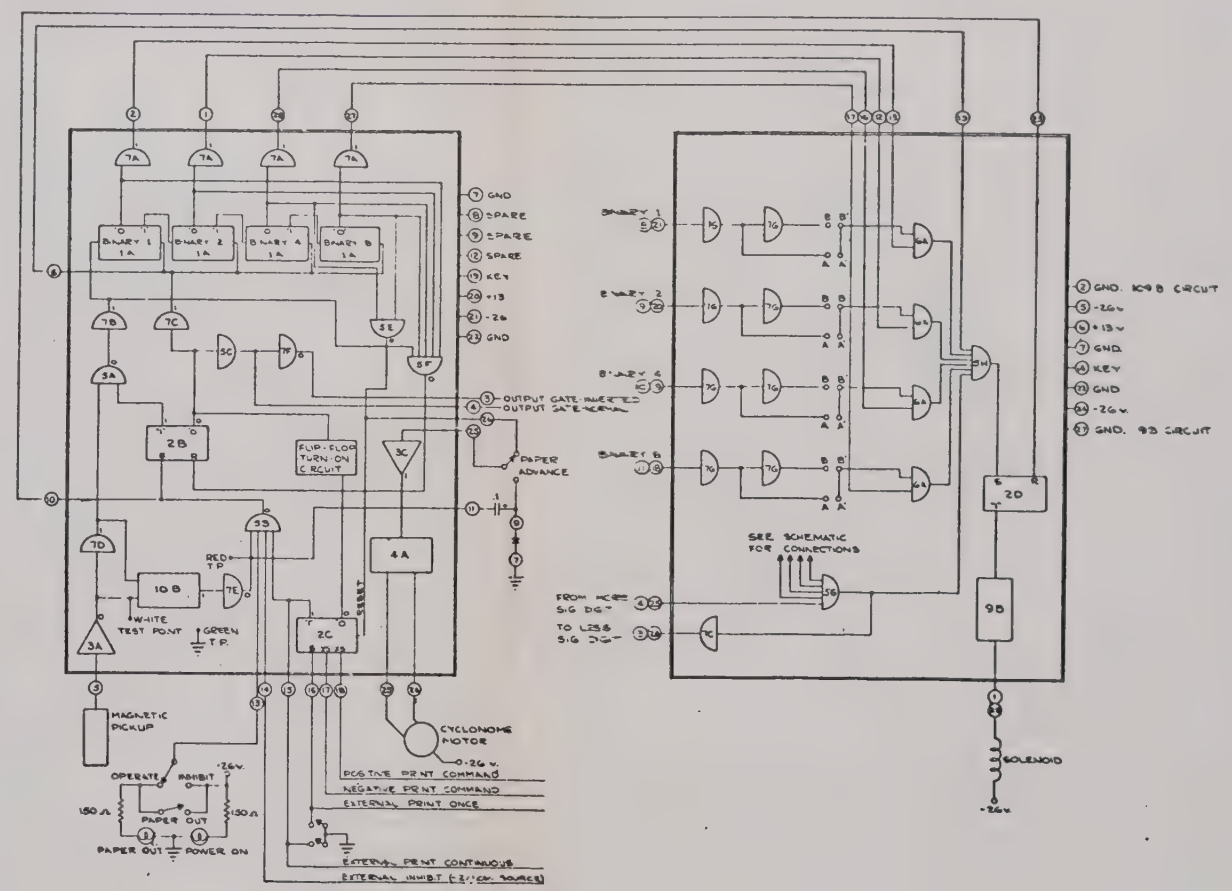
c. The input to all 'and' gates must be '0' state in order to get '1' output (see Table 3-1); if either input to an 'or' gate is logical '1' the output will be a '0' state (see Figure 3-2).

d. The polarity signs on the flip-flop circuits indicate the polarity of the pulse (either the leading or trailing edge) required to activate that circuit.

e. The pin connections of each board are indicated by small circled numbers outside the solid-couble lines.

J-2 BOARD
LOGIC CONTROL
1 PER PRINTER

H-2 BOARD
COLUMN DRIVER
2 CIRCUITS PER BOARD



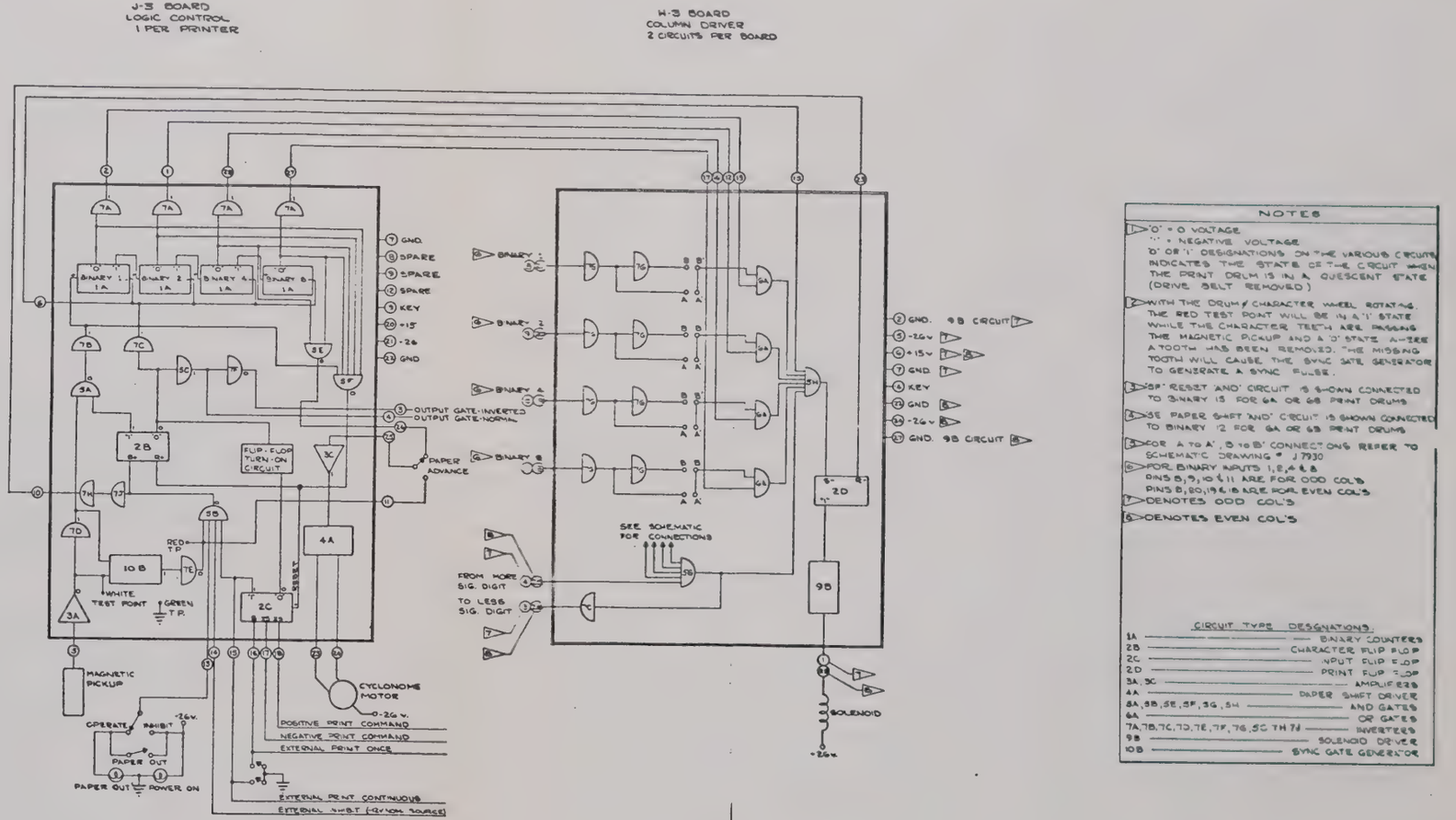
NOTES

1. '0' = 0 VOLTAGE
   '1' = NEGATIVE VOLTAGE
   0 OR 1 DESIGNATIONS ON THE VARIOUS CIRCUITS INDICATES THE STATE OF THE CIRCUIT WHEN THE PRINT DRUM IS IN A QUIESCENT STATE (DRIVE BELT REMOVED).
2. WITH THE DRUM / CHARACTER WHEEL ROTATING, THE RED TEST POINT WILL BE IN A '1' STATE WHILE THE CHARACTER TEETH ARE PASSING THE MAGNETIC PICKUP AND A '0' STATE WHERE A TOOTH HAS BEEN REMOVED. THE MISSING TOOTH WILL CAUSE THE SYNC GATE GENERATOR TO GENERATE A SYNC. PULSE.
3. 'BF' RESET 'AND' CIRCUIT IS SHOWN CONNECTED TO BINARY 15 FOR 6A OR 6E PRINT DRUMS.
4. 'BE' PAPER SHIFT 'AND' CIRCUIT IS SHOWN CONNECTED TO BINARY 12 FOR 6A OR 6B PRINT DRUMS.
5. FOR A TO A', B TO B' CONNECTIONS REFER TO SCHEMATIC DRAWING # B276.

CIRCUIT TYPE DESIGNATIONS

1A	BINARY COUNTERS
2B	CHARACTER FLIP FLOP
2C	INPUT FLIP FLOP
2D	PRINT FLIP FLOP
3A, 3C	AMPLIFIERS
4A	PAPER SHIFT DRIVER
5A, 5B, 5E, 5F, 5G, 5H	AND GATES
6A	OR GATES
7A, 7B, 7C, 7D, 7E, 7F, 7G, 5C	INVERTERS
9B	SOLENOID DRIVER
10B	SYNC GATE GENERATOR

FIGURE 3-6a
LOGIC DIAGRAM B-1200 PRINTER



NOTES

1. '0' = 0 VOLTAGE
   '-' = NEGATIVE VOLTAGE
   '0' OR '1' DESIGNATIONS ON THE VARIOUS CIRCUITS INDICATES THE STATE OF THE CIRCUIT WHEN THE PRINT DRUM IS IN A QUIESCENT STATE (DRIVE BELT REMOVED)
2. WITH THE DRUM / CHARACTER WHEEL ROTATING, THE RED TEST POINT WILL BE IN A '1' STATE WHILE THE CHARACTER TEETH ARE PASSING THE MAGNETIC PICKUP AND A '0' STATE A TEETH WAS BEEN REMOVED. THE MISSING TOOTH WILL CAUSE THE SYNC GATE GENERATOR TO GENERATE A SYNC PULSE.
3. 5B' RESET 'AND' CIRCUIT IS SHOWN CONNECTED TO BINARY 1S FOR 6A OR 6B PRINT DRUMS
4. 5E PAPER SHIFT 'AND' CIRCUIT IS SHOWN CONNECTED TO BINARY '2 FOR 6A OR 6B PRINT DRUMS
5. FOR A TO A', B TO B' CONNECTIONS REFER TO SCHEMATIC DRAWING # J 7930
6. FOR BINARY INPUTS 1, 2, 4 & 8
   PINS 5, 9, 10 & 11 ARE FOR ODD COL'S
   PINS 8, 20, 19 & 18 ARE FOR EVEN COL'S
7. DENOTES ODD COL'S
8. DENOTES EVEN COL'S

CIRCUIT TYPE DESIGNATIONS:

1A	BINARY COUNTERS
2B	CHARACTER FLIP FLOP
2C	INPUT FLIP FLOP
2D	PRINT FLIP FLOP
3A, 3C	AMPLIFIERS
4A	PAPER SHIFT DRIVER
5A, 5B, 5E, 5F, 5G, 5H	AND GATES
6A	OR GATES
7A, 7B, 7C, 7D, 7E, 7F, 7G, 7K TH 7J	INVERTERS
9B	SOLENOID DRIVER
10B	SYNC GATE GENERATOR

FIGURE 3-6b
LOGIC DIAGRAM C-1200 & 1600 PRINTER

3.4.3 Pulses: A series of pulses are generated by a toothed gear and reluctance type (magnetic) pick-up. Each tooth of the gear generates a sinusoidal wave as it passes over the pick-up cartridge. A sync pulse is generated (by the 10B 'Sync'generator) whenever a gear tooth is missing. All pulses from the pick-up cartridge enter the 'J' Board through pin 5.

3.4.4 Control Circuits. The signal from the reluctance pickup is clipped and amplified by the first stage of the 3A amplifier. A second stage then re-inverts and squares both the leading and trailing edges of all pulses.

The negative - going square wave pulses leaving the 3A amplifier, enter 10B 'sync' generator and also pass through the 7D inverter to the 5A character-pulse 'and' gate 5A. They are blocked by the 2B flip-flop which normally holds one leg of the "and" gate. the logical '1' state.

The 10B 'sync' gate generator is designed to produce a single pulse whenever the series of out-of-phase pulses (from 3A and 7D) are interupted at the input. This pulse is the 'sync' pulse and is used to begin a print cycle.

If all of the conditions described in Section 3.4.1 are present, this sync pulse 'passes through' the 5B 'and' gate; the leading edge re-sets the 2D flip-flop on the 'H' board; the trailing edge produces three effects:

a. Sets the 2B character 'flip-flop'; this removes the inhibit (logical '1') signal from the 5A character 'and' gate which then permits the following character pulses to pass into the binary counter.

b. Removes the re-set voltage (through 7C) from each stage of the binary counter. The character pulses that follow can now advance the output stage of this counter.

c. Removes the 'inhibit' from the 5H'and' gate on the 'H' Board; this will permit the solenoid to 'fire' when coincidence occurs between the 4 wire input signal and the output of the binary counter.

3.4.5 Binary Counters. The input to the binary counter is the character pulses from the 7B inverter. The output of the counter is compared with the unknown input code until coincidence occurs (Section 3.4.6a). At that time an output pulse is developed at the 5H 'and' gate; this pulse, after power amplification at 9B, drives the individual print solenoid.

a. Standard Counters. The standard counter in the MDS printers counts in straight binary fashion. Before the print cycle begins however, the output of the binary counter is held to a re-set condition of Binary 15 (1-1-1-1) by the 7C circuits.

b. Permutted Counters. In the standard Series 1200 printers, three different input codes (8-4-2-1, 4-2-2-1, and 2-4-2-1) are accomodated by indexing the print drum on its shaft to one of three positions (See Table 1-5) In order to change codes in the Series 1600 printer (and also for some special cases in the Series 1200), it is necessary to permute the binary counter. This is a permanent change in the counter, and if it is necessary to re-change the input code, a new logic (J) board is required.

When using a printer with a permuted counter, remember that permuted codes usually have only 10, valid, four-bit codes defined, as opposed to the 8421 straight binary code which has 16. If one of the 6 invalid codes is used, a character will print which is related to the 8-4-2-1 code (see 5.3.5 a & b) This is an inherent characteristic of binary codes and is mentioned for reference only.

3.4.6 Solenoid Control. On each "H" board there are two complete sets of comparison and solenoid Drive circuits.

a. Comparison Circuit. The comparison circuit is used to match the external four wire binary input code with the four wire binary code from the counter.

The comparison circuit consists of four 6A "or" gates and one 5H "and" gate, as shown in Figure 3-7.

Coincidence will occur at the 5H 'and' gate (its output will change from '0' to '1') only when all inputs are logical '0'. This occurs when,

1. The output of all four 6A 'OR" gates is logical '0'.

2. The inhibit line (pin 15) is logical '0'.

3. Zero suppression circuits are at logical '0' (this is an optional feature and is found only on those columns where it is specifically requested.

b. Solenoid Driver. The 9B solenoid driver circuit is a one-shot multivibrator pre-set for approximately 1.3 MS 'on' time, It is controlled by the 2D flip-flop which is reset at the start of print cycle.

3.4.7 Paper Advance. Paper advance is controlled by the output of the binary counter; the signal to advance the paper is normally given at the count of 12. However, this may be changed when print speed is increased.

External paper advance (optional extra) must be a negative-going pulse. It is fed directly into the 3C amplifier. The external paper advance signal should not be given for at least 15 MS after the end-of-print signal. This permits the normal paper advance, which is controlled by the MDS circuits, to be completed.

3.4.8 Re-Set. The leading edge of the 16th character pulse advances the state of the counter to binary 15 (1111). The trailing edge of this pulse returns the output of 5F from the logical '1' to logical '0'. This change (a positive-going pulse), then resets the 2B flip-flop which has three effects.

a. Inhibits the 5A character 'and' gate.

b. Changes the input to the 7C inverter which in turn inhibits the counter (no further advance can occur until this inhibit is removed).

c. The end of print gates (normal and inverted) which were present during the print cycle, are returned to their quiescent state.

The print cycle is now complete and will begin again only when the reluctance pick up detects a missing tooth on the gear, (Section 3.4.3) and the initial conditions (Section 3.4.1) are present.

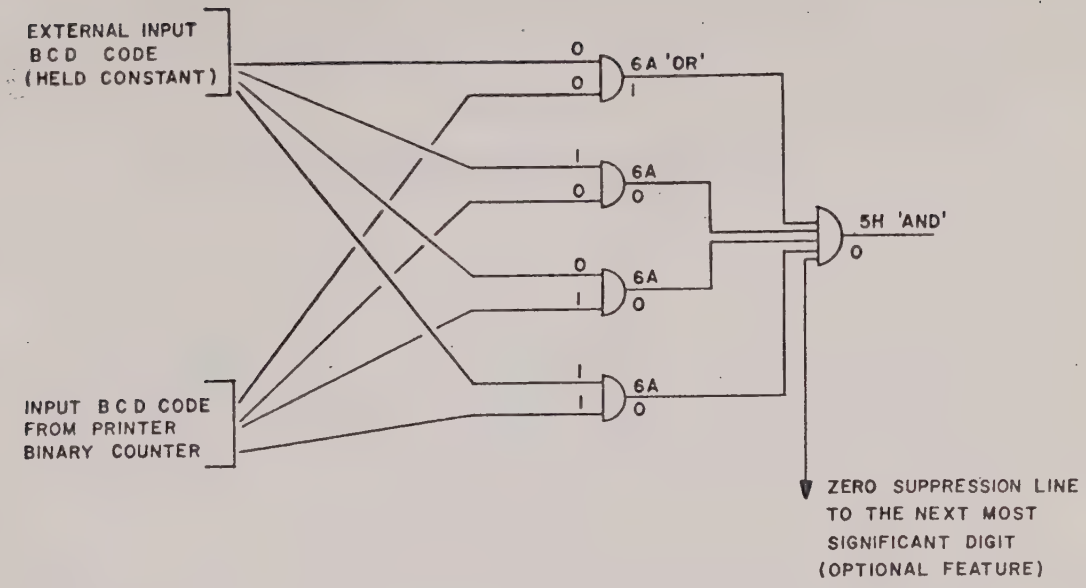


FIGURE 3-7a: INPUT COMPARISON DIAGRAM-MISMATCH

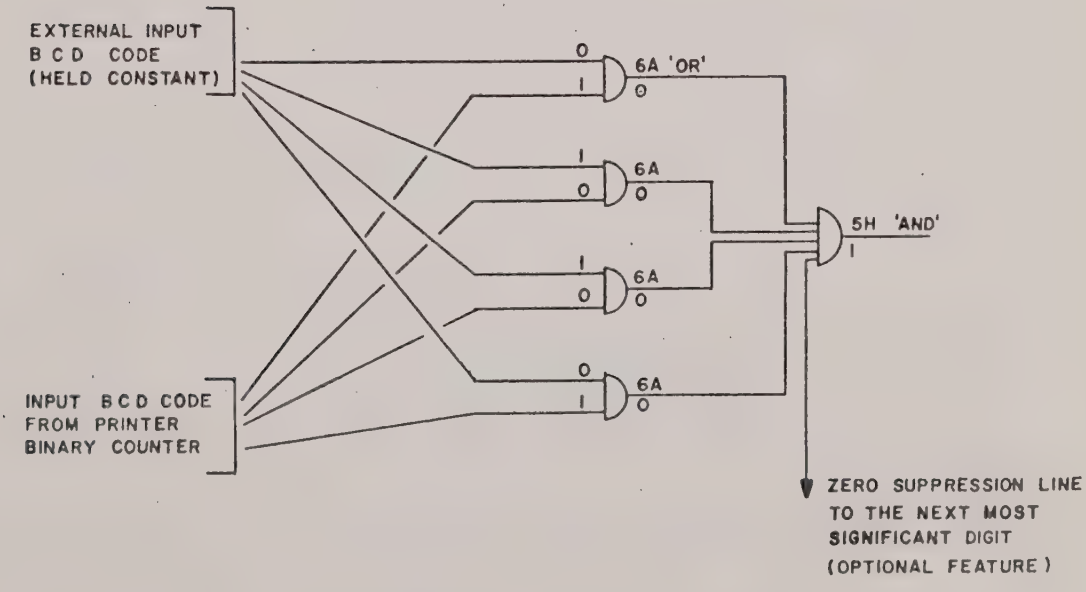
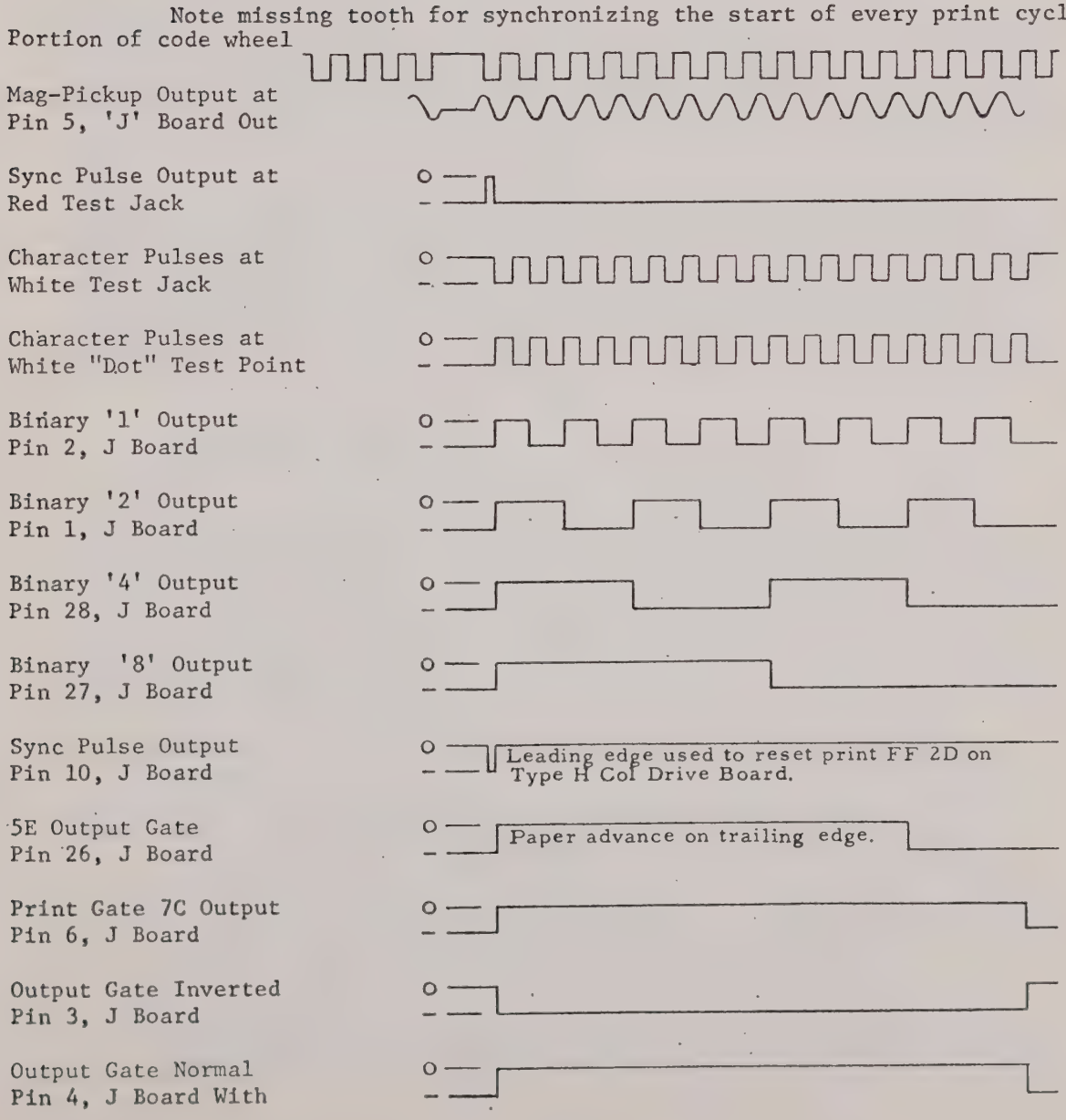


FIGURE 3-7b: INPUT COMPARISON DIAGRAM - COINCIDENCE

Idealized waveforms, relative to code wheel for one print period, with type 'J' board only inserted and print continuous switch depressed. Scope synchronized to start sweep at time zero.

FIGURE 3-8

TIME SEQUENCE CHART FOR TYPE 6B DRUM
1200 & 1600 Series Printers


Note missing tooth for synchronizing the start of every print cycle.
Portion of code wheel
Mag-Pickup Output at Pin 5, 'J' Board Out
Sync Pulse Output at Red Test Jack
Character Pulses at White Test Jack
Character Pulses at White "Dot" Test Point
Binary '1' Output Pin 2, J Board
Binary '2' Output Pin 1, J Board
Binary '4' Output Pin 28, J Board
Binary '8' Output Pin 27, J Board
Sync Pulse Output Pin 10, J Board
Leading edge used to reset print FF 2D on Type H Col Drive Board.
5E Output Gate Pin 26, J Board
Paper advance on trailing edge.
Print Gate 7C Output Pin 6, J Board
Output Gate Inverted Pin 3, J Board
Output Gate Normal Pin 4, J Board With

SECTION 4

MAINTENANCE

4.1 INTRODUCTION. This section describes the periodic and preventative maintenance requirements of the MDS Printer.

4.2 ELECTRONIC MAINTENANCE. The electronic portion of the printer (power supply and printed circuit cards) requires no special maintenance. See Section 5 for trouble shooting procedures.

4.3 CLEANING FAN AIR FILTER. The air filter is located behind a protective screen on the front panel of the printer. (See Figure 2-1). This filter should be removed and cleaned once every 40 operating hours under normal atmospheric conditions. In very dirty atmospheres it should be cleaned more often while in air-conditioned buildings the filter may be cleaned once a month.

Remove the filter by unscrewing the four Phillips-head machine screws which fasten the filter to the printer front panel. The fan filter may be washed in warm soapy water and blown dry with compressed air. Do not use solvents to clean the filter which may be detrimental to the filter material. Replace the filter and orient the screen perforations to slop down toward the front.

NOTE

A dirty air filter will restrict cooling air flow to the printer and impair performance.

4.4 LUBRICATION OF PRINT DRUM DRIVE MOTOR. The main drive motor should be lubricated once a year with one drop of good instrument oil in each bearing. The motor is exposed when the mechanism dust cover is removed (Figure 4-1). A drop of oil should be placed on the felt packing of each bearing. The left hand felt, at the drive end, can be reached through a lubrication hole in the motor end bell approximately 1/4" from the shaft. The rear or right hand bearing lubrication hole is oiled by following the procedure outlined below:

4.4.1 Unplug the main power cord and remove the paper shift knob and control panel.

4.4.2 Expose the opening in the right side of the paper table and locate the access hole in the main casting. This hole is marked in red.

4.4.3 A hypodermic needle or clock oiler may be inserted through this hole into the right bearing hole of the motor. This may be observed by looking into the lower left corner of the mechanism.

4.4.4 Place one drop of oil in the bearing hole of the motor. It is advisable to cover the hammer solenoids during this operation with a piece of paper to prevent oil from accidentally reaching the solenoids.

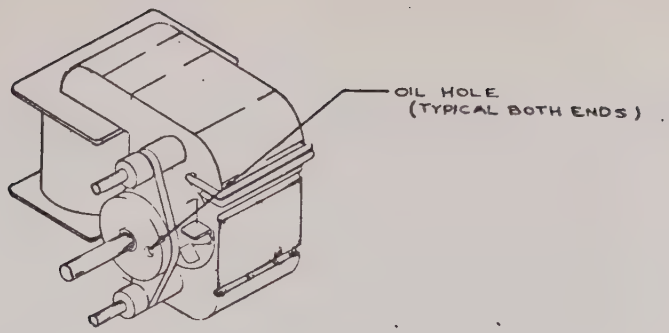


FIGURE 4-1: LUBRICATION POINT, PRINT DRUM MOTOR

4.5 CHANGING RIBBON AND CLEANING PRINT DRUM. The ribbon in the MDS Printer should be changed approximately every million lines. The print drum should also be cleaned every million lines, or when sufficient ribbon lint has adhered to the print drum to blur the printed characters. Usually it is convenient to do both of these operations at the same time. The drum can be cleaned with a typewriter cleaning brush, either with the ribbon removed or in place. In either case, place a sheet of paper between the drum and the paper table to catch the lint which is brushed off.

4.5.1 Changing Inked Ribbon (Figure 2-3). Before removing the old ribbon, observe how it is threaded. The ribbon is fed from the top of the spool, between the black guide pin and microswitch reversing arm, between the bottom ribbon guide pins and anti-smear shim, between the opposite black ribbon guide pin and microswitch reversing arm, and over the ribbon spool.

Remove the old ribbon as described in Section 2.4.

4.5.2 Removing the Print Drum. If it is desired to remove the print drum for a more thorough cleaning, remove the drum retainer by holding the drum fast and unscrewing the retainer counter-clockwise. (See Figure 1-3). Observe the font and character orientation relative to the shaft key position. This same keyway in the drum must be used when the drum is reinstalled. For a familiarization of the drum fonts see Table 1-5.

NOTE

Handling the Print Drum

Move the drum out approximately 1/2 inch so that it may be grasped firmly on the sides with both hands when standing on the right side of the printer. Pull the drum forward

and firmly; it is heavy and care should be taken not to drop it. Clean the drum with chlorethene and a typewritter brush to remove ink between the characters.

Before reinstalling the drum, lubricate the bore and both sides of the drum with a coat of good quality rust-preventative oil. Orientate the drum on the shaft so that the higher numbered digits are to the right of the operator. Start the drum on the drive shaft slowly and then push the drum toward the left side of the printer until it is fully engaged on the shaft. Replace the drum retainer.

SECTION 5

TROUBLE SHOOTING

5.1 INTRODUCTION. This section describes the normal trouble shooting and repair instructions for the MDS printer. Section 5.2 describes procedures to be followed when repair of the printer mechanism is required. Section 5.3 describes trouble shooting techniques for the repair of the printer electronics. Table 5-1 serves as a quick reference for repair instructions based upon malfunction symptoms. This table is arranged in decreasing order from completely inoperative symptoms to symptoms requiring only minor adjustments.

5.2 MECHANICAL MALFUNCTIONS

5.2.1 Paper Handling. A variety of problems may arise if the paper supply or feed system should malfunction. Primarily the format of print produced will be erratic; for example, the lines and columns of print will not be straight and, spacing between characters will not be uniform. To determine if the failure is electrical or mechanical replace the 'J' Board with a spare. If the problem continues with the new board in place, a mechanical malfunction is the probable cause.

a. Paper Motion. To check the drag on the paper tape, lock the mechanism in its' normal position in the printer chassis and depress the paper release knob; pull the paper forward by hand, The force necessary to pull the paper through the mechanism should be approximately 45 grams.

Excessive paper drag may be caused by the use of paper wider than the guide area, improperly threaded paper tape, improper rake adjustment, improper tension in the paper advance mechanism, improper paper tracking, or a damaged anti-smear shim.

b. Improperly Threaded Paper Tape. Verify that the paper is threaded in accordance with Section 2.3, Figures 2-2a and 2.2b.

Roll paper should be arranged to feed from the roll bottom, over the tension spring, and thread between the paper table and anti-smear shim.

Fanfold paper is used without a tension spring in the printer. The paper should feed from the top of the pack and thread between the paper table and anti-smear shim.

If the paper is threaded above the anti-smear shim, the following could occur: the paper may not track properly causing irregularities in the vertical columns of print, ink smudges may appear on the tape, the paper out switch may actuate and prevent the printer from printing.

c. Paper Rake Adjustments. If the paper is able to move against the rake back into the mechanism, the rake is not set properly. (See Figure 5-1). All 6 of the rake tines should be in contact with the paper to hold it firmly against the paper table. When the paper is given a gentle side-to-side motion, the tines should follow this motion easily.

NOTE

The rake must not be too tight, or the tines will inhibit the forward motion of the paper. Its setting can be checked with a strip of paper under the rake and the drive mechanism released. The paper should slide forward easily, but not backward into the mechanism. Resistance to pull is normally about 45 grams.

If necessary, the rake can be re-set by loosening the adjustment screw (Figure 5-1), and by rotating the rake assembly until there is enough force to hold the paper to the table. With proper adjustment, the tines will touch the paper just hard enough so that they will be slightly curved. If they press too hard, they will cause too much drag and spoil proper shift.

d. Paper Advance Mechanism Adjustment. The tension screw on the paper advance mechanism controls the pressure between the drive and idler wheels. Too light a setting may cause uneven spacing of printed lines. The tension can be checked as follows (Figure 5-1).

1. Remove the dust cover from the mechanism; attach a spring scale (25 oz. full scale) to the midpoint of the top of the paper release knob.

2. Operate the printer at its maximum printing speed. Apply force to the spring scale enough to stop the paper from advancing. This force should be between 11 - 13 ounces. If adjustment is required, adjust the tension screw with a 5/64" allen wrench until the tension at the idler wheel mount is between 11 and 13 oz.

e. Paper Tracking Adjustment. If the paper tends to skew against the guide rails, excess paper drag or wrinkling may occur; this indicates that the paper tracking is out of adjustment. It may be corrected as follows:

1. Loosen the pivot and clearance screws (See Figure 5-1).

2. Operate this printer so that the paper advances through the mechanism.

3. Track the paper correctly between the guide rails by moving the "paper release" lever horizontally.

4. Tighten the pivot and clearance screws.

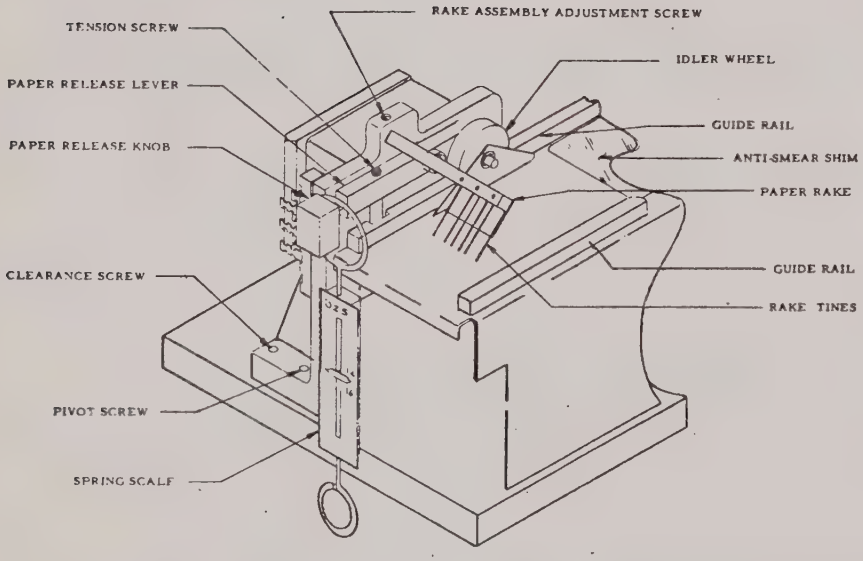


FIGURE 5-1: PAPER ADVANCE MECHANISM ADJUSTMENT

5.2.2 Printer Phasing. If the printer is out of phase, examination of print samples produced should reveal that the printed characters are consistently shifted a distance equivalent to a fraction or multiple of character pitch. Initially, it must be determined whether all columns are shifted or just individual columns are out of phase. Secondly it must be determined if the misalignment resulted from a change in input power frequency. Instructions for rephasing all columns of a standard printer are given in Section 5.2.2a, individual column adjustment in Section 5.2.2b and rephasing a printer built with the 50 cps input power option in Section 5.2.2c/

a. Phasing Standard Printer

1. Initial Phasing. In the event that the timing gear is completely out of adjustment, the following procedure should be used. (See Figure 5-2.

a. Loosen the two set screws that hold the timing gear on the drive shaft and also the two set screws holding the adjusting block to the drive shaft.

b. Rotate the print drum so that the zero of the font being used is in the top most position.

c. Rotate the timing gear with respect to the drum so that the second tooth after a space is in line with the magnetic pickup when the needed zero is in the top most position.

d. Tighten the two set screws in the adjusting block.

e. Tighten (just snug) the two set screws in the timing gear. Follow Section 5.2.2a, b for Full Line Adjustment

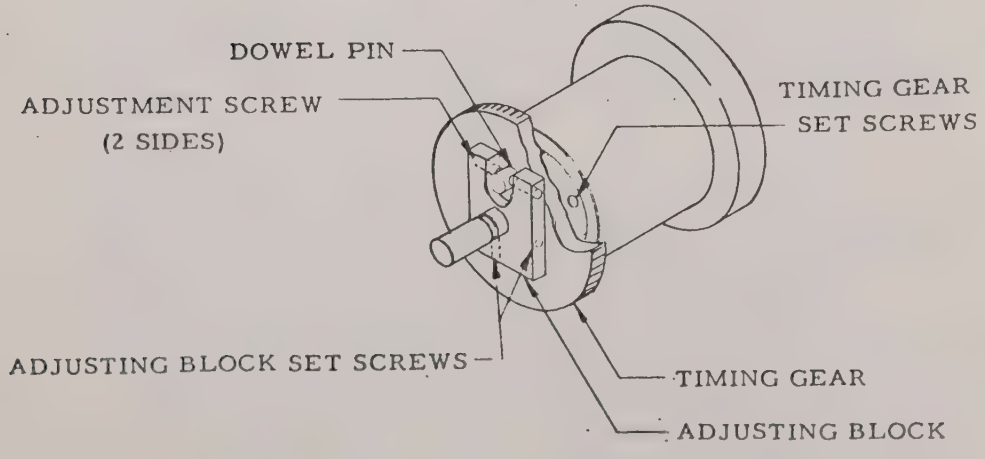


FIGURE 5-2: FULL LINE (TIMING GEAR) ADJUSTMENT

5.2.3 Full Line Adjustment. A full line adjustment is required when all of the columns print the correct numbers but either the top or bottom of another line of characters also shows. Check the AC voltage input to the printer; the instrument was aligned at the factory on 115 volts input; 105 volts input or less could cause the print drum to rotate less than 600 RPM which would cause such misalignment to a small extent.

Check for undue drag on the drum shaft. Examine the drive belt or any part associated with the character drum drive. Pieces of paper, a large accumulation of lint, or excessive dirt could cause the drum to rotate at less than 600 RPM.

Normally, it is not required to make an adjustment for overall vertical alignment during the life of the printer. If such an adjustment is required, however, it is performed by rotating the timing gear (either advancing or retarding it) in a direction that is relative to the print drum rotation. If the timing gear must be aligned, proceed as follows:

a. Preparation for Adjustment. Remove the A-C power cord from the source and then remove the dust cover from the mechanism.

b. Coarse Adjustment of Timing Gear. Loosen the two set screws that lock the adjusting block to the drive shaft, (see Figure 5-2). Also loosen the two set screws that clamp the timing gear to the drive shaft. The fine adjustment set screws, which bear against the dowel pin protruding from the timing gear, need not be loosened for coarse adjustments.

c. If the top portion of a line of characters appears under the desired line of print, advance the timing gear periphery a distance equivalent to an estimated fraction of character pitch misalignment. If the bottom portion of a line of characters appears above the line of print retard the timing gear periphery.

d. Lock the adjusting block in its new position on the drive shaft by tightening the set screws. Clamp the timing gear to the drive shaft by tightening the set screws. The timing gear set screws bear against nylon clamp inserts to permit slippage when fine adjustments are made.

5.2.4 Fine Adjustment to Eliminate Character Clipping. To eliminate clipping of the line of characters, advance the timing gear for top clipping or retard it for bottom clipping a distance equivalent to an estimated fraction of character pitch misalignment.

a. To advance the timing gear, loosen the screw which contacts the forward part of the dowel pin and tighten the set screw which contacts the rear part of the dowel pin. To retard the timing gear, loosen the screw which contacts the rear part of the dowel pin and tighten the set screw which contacts the forward part of the dowel pin. Both screws bearing on the dowel pin should be tightened to complete the adjustment.

5.2.5 Individual Column Adjustment. Vertical alignment of an individual column should not be required during the normal life of the printer. When necessary, however, this adjustment may be made with the adjusting screw for that column (See Figure 5-3) as follows:

1. Determine which solenoid must be adjusted by counting the printed columns on the paper tape from left to right.

2. The adjusting screws are accessable through a large, milled slot in the base plate. Locate the column requiring adjustment be counting the adjusting screws from right to left as seen when facing the printer mechanism base.

3. Adjust this screw counter-clockwise if the printed character must move up for proper line adjustment; adjust this screw clockwise if the printed column must move down.

NOTE

USE CAUTION when adjusting these screws; a 5^{o} or 10^{o} adjustment is usually all that is required.

WARNING

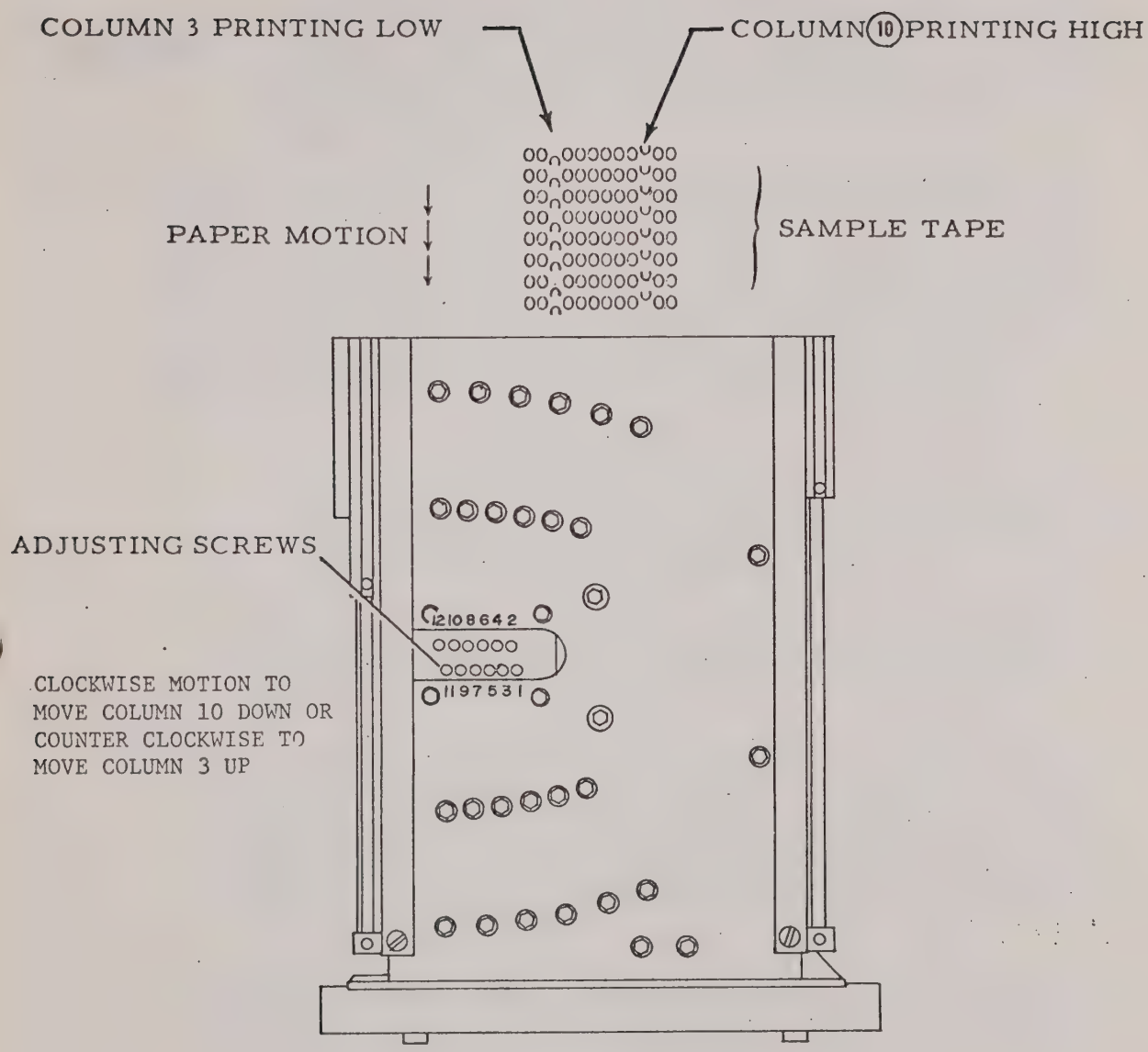
Motion of the screw in a clockwise direction of approximately 60^{o} will jam the solenoid closed. Continued rotation in the same direction will first damage the solenoid and then the hammer and drum. The beginning of the area in which damage will occur cannot be felt when turning the adjusting screw; therefore, great care should be exercised by persons making this adjustment. Damage to the printer which results from a careless or improper adjustment is not covered by warranty.

5.2.6 Phasing 50cps Printer. Printers may be operated with 50 cps 115V input power only when this capability is supplied as a printer option. Printers supplied with the 50 cps option will also operate with 60 cps input power provided phasing adjustments are made with the timing gear. Print rate will vary when the input power frequency is changed.

WARNING

Standard printers are built only for 60 cps operation and must not be operated with 50 cps input power.

1. 50 to 60 cps Rephasing. Coarse adjust according to Section 5.2.3b for power change from 50 to 60 cps by advancing the timing gear a peripheral distance equivalent to the pitch of one character tooth on the timing gear (approximately 0.1 inches.) Fine adjust as in Section 5.2.4a, if necessary.



CAUTION:

A 5^{o} - 10^{o} adjustment is usually all that is required to realign a column.

A clockwise adjustment of 60^{o} or more will jam and destroy the solenoid and possibly the print drum.

FIGURE 5-3: INDIVIDUAL COLUMN (HAMMER SOLENOID) ADJUSTMENT

2. 60 to 50 cps Rephasing. Coarse adjust according to Section 5.2.3b for power change from 60 to 50 cps by retarding the timing gear a peripheral distance equivalent to the pitch of one character tooth on the timing gear (approximately 0.1 inches). Fine adjust as in Section 5.2.4a, if necessary. NOTE: This adjustment is to be made only with printers equipped for 50 cps operation.

5.3 ELECTRONIC MALFUNCTIONS. Because of the simplicity of the logic and the conservative design of the circuitry, the electronic portion of the MDS Printer is relatively trouble-free. When repair is necessary, however, a thorough understanding of the printer logic will enable the technician to quickly determine which circuits are at fault. Therefore, before attempting to repair the Printer, first become familiar with the Principles of Operation (Section 3), the Logic Diagram (Figure 3-6), the time sequence chart (Figure 2-5), and the basic electronic circuitry in the printer.

WARNING

Never remove or plug-in a printed circuit card unless all power to the printer is turned off. Severe damage to components on the printed circuits will otherwise result. Warranty to the printer will be voided under such condition.

5.3.1 General. Each MDS Printer differs with regard to the number of columns and their location, but the basic logic or sequence of events which leads to the printing of a particular character is the same for all.

The logic diagrams (Figure 3-6), identifies the individual circuits of the printer in the quiescent state. (See Section 3.4.2) Each circuit is marked with either a '0' or a '1', and the polarity of the pulse required to 'set' and 'reset' each flip-flop. Circuits marked with a '0' indicate that circuit to be 'on' or the transistor saturated. Circuits marked with a '1' indicate that circuit to be cut 'off' or non-conducting.

Binary '0' is equal to 0 volts and binary '1' is equal to a negative voltage (generally -12 volts) with respect to the instrument ground. No external data source will be required in the trouble shooting procedure. Control of the printer will be from the front panel.

5.3.2 Test Equipment and Service Aids.

a. Sensitive multimeter or V.T.V.M.

b. Oscilloscope with one microsecond resolution or better and a calibrated time base.

c. One set of extender boards.

d. One set of spare electronic boards.

e. One 6-volt battery.

5.3.3 Fuse Location and Function

a. Main power fuse. This fuse is located on the rear panel of the printer. It is in the main A-C line and carries the entire printer load. The fuse is rated at 5 amps for 115 V service and 3 amps for 230 V service.

b. Power Supply Fuses. There are two fuses located on top of the power supply; one in series with the positive voltage output (1 amp. regular), and one in series with the negative voltage output (6 amp. regular).

A quick way to determine whether the positive fuse is open without removing the top cover is as follows: Observe the direction of travel of the inked ribbon. If the ribbon is winding onto the front spindle, manually actuate the rear snap-action switch. If the direction of travel reverses, the positive supply fuse is good. (The positive voltage actuates the relay in the ribbon reverse circuit (See Figures 6-11 and 6-12). Conversely, the fuse is open if the direction of travel does not reverse.

c. Printer Mechanism Fuse. The printer mechanism fuse(1 amp. regular) is located on the left side of the printer mechanism. It is in the AC line to protect the drum and ribbon-reverse motors.

d. Hammer Solenoid Fuses. Each solenoid is protected with a 1 ampere "Picofuse" made by Little Fuse Co. (Part No. 276001). Two of these fuses are located on each "H" Board, one for each driver circuit.

5.3.4 Power Supply. The power supply is manufactured for MDS by Transistor Devices, Inc. It was specifically designed for the MDS Printer and consists of two separate supplies in a single package; it delivers -26.0 volts (adjustable) at five (5) amperes for the print solenoids and logic circuits; and +15 ± 10% volts at 0.5 amperes (not adjustable) for transistor bias in the logic circuits. The output of the negative supply is regulated to better than 1.0% with an overall 20% line variation. The circuits are straight-forward and may be serviced by using standard components when necessary.

a. Test Procedure

1. Turn off the AC power; remove all of the printed circuit boards; turn on the AC power.

2. Measure the positive supply voltage between terminals 6 and 7 it should be +15V ±10%.

3. Measure the negative supply voltage between terminals 10 and 9; it should be -26 ±1.0%.

5.3.5 General Electronic Trouble Shooting.

a. Wrong characters printing. Sections 5.4.9 and 5.4.10 of the trouble shooting reference Table 5-1, describe several causes of the subject malfunctions. Refer to Section 5.2.2 to determine if phasing is the problem, and Section 5.3.5.1 below to determine if the print drum is indexed to the proper position and the correct counter is being used. If neither the former nor the latter is the cause, check the printer electronics as follows:

1. Disconnect the data input plug from the printer to eliminate the data source as the possible cause. Refer to the data input pin connector charts Figs. 1-6a or b, and connect a six volt battery between circuit common and the proper pins associated with the binary number causing incorrect print-out. Depress the print continuous switch. Observe the print in the columns or column programmed by the battery. If the character printed matches the code programmed, the original data source should be checked. Verify that the input logic voltage level is held constant while printing. If incorrect print-out still exists, pull out the column drive board (H type) associated with the column printing incorrectly, and substitute another column drive board known to be printing correctly. This will determine whether the trouble is located on the board or the wiring from the code input jack. Refer to electronic circuit trouble shooting if the 'H' type board is the cause of the trouble. If wrong print still persists substitute a spare logic 'J' Board.

2. In correct printout will also result if the print drum is improperly indexed or the wrong counter (on logic J-Board) is used. The standard Series 1200 printer which operates at 20 lines per second will accept three different input codes (8421, 4221, and 2421) which are accomodated by indexing the print drum on its shaft to one of three positions. However, the input code cannot be changed by indexing the print drum on the standard 1600 printer or printers supplied with the 30 or 40 LPS printing speed option. In order to change codes with these printers it is necessary to permute the binary counter on the logic J-Board.

   This permutation is a permanent change in the counter. If it is desired to use the printer with one code at one time and another code at another time, it is necessary to have separate logic control boards, one for each code.

   When using the 4221 board or the 2421 board the following should be remembered: The 4221 and 2421 codes have only 10 valid four bit codes, as opposed to the 8421 code which has 16. If the printer is used with the 4221 or 2421 board and one of the 6 invalid codes are used, a number which is not related to any code will print in four of the six cases. Thus, if the printer is accidentally used with an 8421 input code and the 4221 board, wrong print will occur, which looks

normal on the tape except for the fact that the wrong characters are printed.

Listed below are the six code combinations of the 8421 code dropped as a result of permutation and the numbers that each code will print if that code were programmed into the printer. (The first two codes print correctly with either board.)

Bits 8 4 2 1	Will Print
0 1 0 0	4
0 1 0 1	5
1 0 0 0	6
1 0 0 1	7
1 0 1 0	8
1 0 1 1	9

This is an inherent characteristic of the MDS printer, and is mentioned for your information only.

5.3.6 Circuit Trouble Shooting Procedures.

a. Introduction. An analysis of the electronic logic and associated waveforms should suggest which printed circuit board and which circuit on that board is not operating properly. That board should be replaced with a spare and returned to the factory for repair. However, if field service is necessary, a qualified technician can quickly locate the faulty component as follows:

b. Component Checkout Procedures. Two thirds of the total circuits in the MDS printer are composed of resistors and transistors. The remaining one-third circuits include capacitors and/or diodes.

1. Diodes. The diodes in the MDS printer are used as electronic check valves; their operation may be checked with an ohm meter without removing them from their circuits. Check the ratio of forward to reverse resistance. Refer to the schematic diagrams in Section 6.

2. Transistors. All transistors used in the logic portion of the MDS printer are 2N404's and are used exclusively as electronic switches. That is, they are either conducting (saturated) or they are not conducting (cut off). A short circuit or open circuit in a transistor may be determined without removing it from its circuit as follows:

a. Turn off the AC power; insert the questionable board in an extender board in an extender card, insert this card

back into the printer; turn the AC power on again.

b. Connect one lead of 10,000 ohm 1/2 watt resistor through a convenient length of insulated wire to the -26V supply (pin 10 and 11 on the power supply) barrier strip.

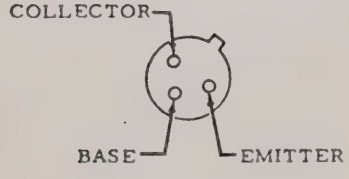
c. Touch the other end of the resistor to the base of the transistor to be tested and monitor the collector with a voltmeter. If the transistor is normally "off", the meter should measure -13V with the probe removed, and -0.1 volts or less with the probe on the base.

NOTE

If the circuit checked is a flip-flop, the meter should remain at -0.1 volts after the probe is removed. To switch the circuit back to its original condition, touch the probe to the base of the other transistor in the flip-flop circuit. If the voltmeter again indicates a negative voltage, both transistors in the flip-flop circuit are working properly. However, this test indicates only that the transistor elements are not open or shorted and should be used only for this purpose. A transistor with low current gain will probably respond to this test in a flip-flop circuit and may not switch when subjected to the normal operating pulses. In this instance both transistors should be replaced.

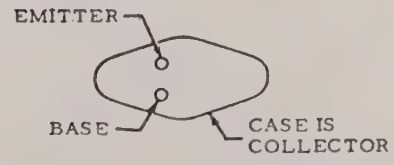
d. A transistor normally turned 'on' (0 state) may be checked with the same probe, but with the wire lead connected to the +15V supply (Pin #3 of J-Board). Apply the positive voltage through the probe to the base of the 'on' transistor; monitor the collector with a voltmeter. If the transistor is functioning properly, it should turn 'off'.

3. Transistor Pin Connections. Figure 5-4 shows the bottom views of the transistors used in the MDS Printer.



5-4-a

2N 404-PNP
2N3638 PNP (Silicon)



5-4-b

2N 301/2N2869
2N 301A/2870

FIGURE 5-4: TRANSISTOR PIN CONNECTIONS
(BOTTOM VIEW)

NOTE

Routine maintenance and repair of the MDS Printer is facilitated if a set of spare parts is available to the service technician. See the "Recommended Supplies Table 7-2" at the end of this manual.

c. J-Board Checkout. When the logic control board is suspected of mal functioning, remove all of the column drive boards (H type). Turn A-C power off when changing boards). Connect an oscilloscope to the J-Board as follows: Oscilloscope common to green test jack and external sync input to red test jack. Adjust scope sync for positive going pulse (leading edge of pulse from red test jack).

With the print continuous switch depressed, check the output of the various circuits while following the Time Sequence Chart Figure 2-5.

Identification of the type J-Board pin call-out on the waveform chart is accomplished by counting the pins starting with pin 02. Pin 02 is the nearest pin to the side of the basket assembly, adjacent to the power supply. For example: 02, 01, 0, 1, 2,3 - - - 28, 29, 30, 31. Pins 1 to 28 inclusive are used in the Series 1200 and 1600 Printers.

Refer to Logic Diagram Figure 3-6, the board schematic, and Theory of Operation Section 3-4.

d. H-Board Checkout

When the H board is suspected of malfunctioning, check out the 9B solenoid driver circuit and comparison circuit. Refer to Logic Diagram (Figure 3-6). The board Schematic and Theory of Operation (Sections 3.3.6 and 3.4). Measure circuit voltage levels and compare with values on schematic.

TROUBLE SHOOTING REFERENCE TABLE 5-1

Malfunction Symptom	Cause of Malfunction	Repair Instructions
Printer not operating power light of control panel off; motors of printer mechanism not rotating.	a. Main power fuse out	Disconnect AC power. Refer to 5.3.3 for fuse location and rating, then check out printer according to 1.16.
No print; green power light on;motors of printer mechanism running.	a. Printer not receiving print command.	Supply print command according to 1.22. Check pin connections according to Fig. 1-6. Refer to timing chart Fig. 3-8 for proper synchronization of print command.
	b. Negative 12V applied to external inhibit line.	The inhibit line should be at ground potential or open;See 1.10.3.
	c. Inhibit-Operate switch in the "Inhibit" position	Check-out the printer as described in Section 1.16. See Section 1.16.2.
	d. Failure of logic J-Board	Replace J-Board with spare or checkout according to 5.3.6 and 5.3.6c.
No print;green and red panel lights on;paper in printer	a. Paper threaded over anti-smear shim instead of under it.	Rethread paper correctly; See 5.2.1b.
No print; green power light out; drive motor running.	a. Negative 26V power supply fuse burned out.	Disconnect AC power; refer to 5.3.3b and Fig 6-9 for fuse location and rating; refer to 5.3.4 and 5.3.4a for power supply checkout. Then check out printer according to 1.16. NOTE Repeated burnout of power supply fuse may be caused by transistor failure in power supply. Call Factory.

TROUBLE SHOOTING REFERENCE TABLE 5-1 (Cont'd)

Malfunction Symptom	Cause of Malfunction	Repair Instructions
Print drum and ribbon reverse motors not operating.	a. Printer mechanism fuse open	Disconnect the AC power; refer to 5.3.3c and Fig. 6-11 for fuse location and rating. Check-out printer according to 1.16.
Ribbon reverse mechanism not operating.	a. Microswitch malfunctioning or bent actuator lever.	Replace microswitch if defective or straighten lever if bent.Lever should actuate microswitch as ribbon bar approaches. Refer to 3.2.3 and consult Factory.
	b. Malfunction of relay or clutch motor.	Refer to schematic Fig.6-11 and Theory Section 3.2.3. Checkout relay and clutch motors. Replace defective part after consulting Factory. Then checkout printer according to 1.16.
Ribbon Reverse mechanism not operating; repeated burn out of mechanism fuse.	Shorted diode in ribbon reverse circuit	Disconnect AC power. Trouble shoot per 5.3.6b1 and Fig. 6-11; refer to 3.2.3 for theory of operation. Consult Factory on diode replacement.
One or more columns not printing.	a. Fuse out in driver circuit of H-Board.	Disconnect AC power. Remove H-Board and substitute spare.Refer to 5.3.3d and Fig. 6-6 for fuse location and rating.
	b. Mating input connector improperly wired.	Check pin connections according to Figs.1-6a or 1-6b.
	c. H-board is missing (Two columns not printing)	Verify that there is one H-board for every two active columns.
	d. Circuit failure in H-board	Replace H-board with a spare or checkout according to 5.3.6 and 5.3.6d.
Wrong characters printing in one or more columns.	a. Wrong input code	Refer to Table 1-5 and check out per 5.3.5a
	b. Mating input connector improperly wired	Check-out per 5.3.5a1, see pin connection charts Fig. 1.6

TROUBLE SHOOTING REFERENCE TABLE 5-1 (Cont'd)

Malfunction	Cause of Malfunction	Repair Instructions
(Cont'd) Wrong characters printing in one or more columns	c. Circuit failure in H-Board	Replace H-Board with a spare or checkout according to 5.3.6 and 5.3.6d.
Wrong characters printing in all columns.	a. Print drum position out of phase relative to timing wheel	Phase according to 5.2.2a. For 50 Hz printers re-phase according to 5.2.2.c
	b. Print drum indexed to wrong key position on drive shaft	Index the print drum to shaft key position marked with input code being used.
	c. Wrong input code supplied (Standard Printer).	Refer to Table 1-5 and check-out per 5.3.5.a
	d. Wrong Logic "J"Board with permuted counter	Refer to Table 1-5, and check-out per 5.3.5a2.
	e. Code input voltage varing during print cycle	Hold input voltage constant during print cycle. Verify by checking on oscilloscope.
Spacing of character lines is erractic and columns are not straight.	a. Paper loaded improperly	Load paper according to 5.2.1b
	b. Paper rake out of adjustment.	Readjust according to 5.2.1c. See Fig. 5-1
	c. Bent rake tines	Replace rake assembly; refer to 5.2.1c
	d. Paper tracking out of adjustment (Paper not centered.)	Readjust according to 5.2.1e.
	e. Improper tension on release lever of paper advance mechanism	Readjust according to 5.2.1d
	f. Damaged idler wheel	Replace idler wheel. See Fig. 5.1.
	g. Malfunction of J-Board	Replace J-Board with spare or checkout according to 5.3.6 and 5.3.6c.

TROUBLE SHOOTING REFERENCE TABLE 5-1 (Cont'd)

Malfunction Symptom	Cause of Malfunction	Repair Instructions
Clipping of Characters in individual column	a. Hammer flight time screw out of adjustment	Readjust according to 5.2.2 b.
	b. Circuit failure H-Board	Replace H-Board with a spare or checkout according to 5.3.6 and 5.3.6 d.
Clipping of characters in all columns	a. Line voltage below tolerance	See Section 5.2.2a2.
	b. Drag on rotating print drum or drive system	Examine for foreign objects interferring with motion.
	c. Print drum position out of phase relative to timing wheel	Readjust according to 5.2.2.a3 for standard printers and 5.2.2.c for 50 Hz printers.
	d. Negative 26 volt power supply malfunctioning.	Checkout power supply according to 5.3.4.
Paper not stepping.	a. Paper loaded improperly	Load paper according to 5.2.1.b
	b. Paper tension spring is bent.	See Fig.2-2a. Replace paper tension spring.
	c. Improper tension on release lever of paper advance mechanism	Readjust according to 5.2.1 d
	d. Malfunction of J-Board	Replace J-board with a spare or checkout according to 5.3.6 and 5.3.6.c
Paper not centered in guide rails	a. Paper advance mechanism is misaligned causing the paper to track improperly.	Readjust according to 5.2.1e.

SECTION 6

SCHEMATICS

6.1 INTRODUCTION. Schematics and assembly drawings of the printer logic and wiring arrangements are presented in this section.

In order to cover all printed circuit card configurations currently in use, two assembly and schematic drawings are presented for the H-board and J-board. Table 6-1 may be used to identify printed circuit cards and locate the corresponding reference drawing.

TABLE 6-1: PRINTED CIRCUIT CARD IDENTIFICATION

Card Number	Color Code	Description	Reference Drawing	
			Schematic	Assembly
H2	* Yellow	Input Comparitor Board (Slotted Hole for Finger Grip.)	Fig. 6-1 (J-8276)	Fig. 6-2 (D-8257)
J2	Black with white dot	Logic Control and Binary Counter Board (Slotted Hole for Finger Grip)	Fig. 6-3 (D-8278)	Fig. 6-4 (D-8280)
H3	*Yellow	Input Comparitor Board (Two Round Holes for Finger Grip).	Fig, 6-5 (J-7930)	Fig. 6-6 (D3-7971)
J3	Black with white dot	Logic Control and Binary Counter Board (Two Round Holes for Finger Grip).	Fig. 6-7 (J-7965)	Fig. 6-8 (D-8386)

*Black dot in center of color code indicates that the zero suppression option is supplied.

1 SOLENOID DRIVER
2 GROUND 109B
3 ZERO SUPPRESSION LESS SIG. DIGIT
4 ZERO SUPPRESSION MORE SIG. DIGIT
5 -26 VOLTS 100 SERIES
6 +13 VOLTS
7 GROUND - COMPARATORS
8 BINARY 1 100 SERIES
9 BINARY 2 100 SERIES
10 BINARY 4 100 SERIES
11 BINARY 8 100 SERIES
12 BINARY 2 FROM COUNTER
13 BINARY 1 FROM COUNTER
14 KEY
15 INH 3 IT LINE
16 BINARY 4 FROM COUNTER
17 BINARY 8 FROM COUNTER
18 BINARY 8 1 SERIES
19 BINARY 4 1 SERIES
20 BINARY 2 1 SERIES
21 BINARY 1 1 SERIES
22 GROUND - COMPARATORS
23 RESET
24 -26 VOLTS 1 SERIES
25 ZERO SUPPRESSION MORE SIG. DIGIT
26 ZERO SUPPRESSION LESS SIG. DIGIT
27 GROUND 9B
28 SOLENOID DRIVER

CUSTOMER INPUTS

ZERO SUPPRESSION (OPTIONAL) 106A & 107C

10 5H AND

102D FLIP-FLOP

109B SOLENOID DRIVER

107G INV.

106A OR

TYP 8 PLACES

TYP 8 PLACES

6A OR

7G INV.

5H AND

2D FLIP-FLOP

9B SOLENOID DRIVER

NOTES

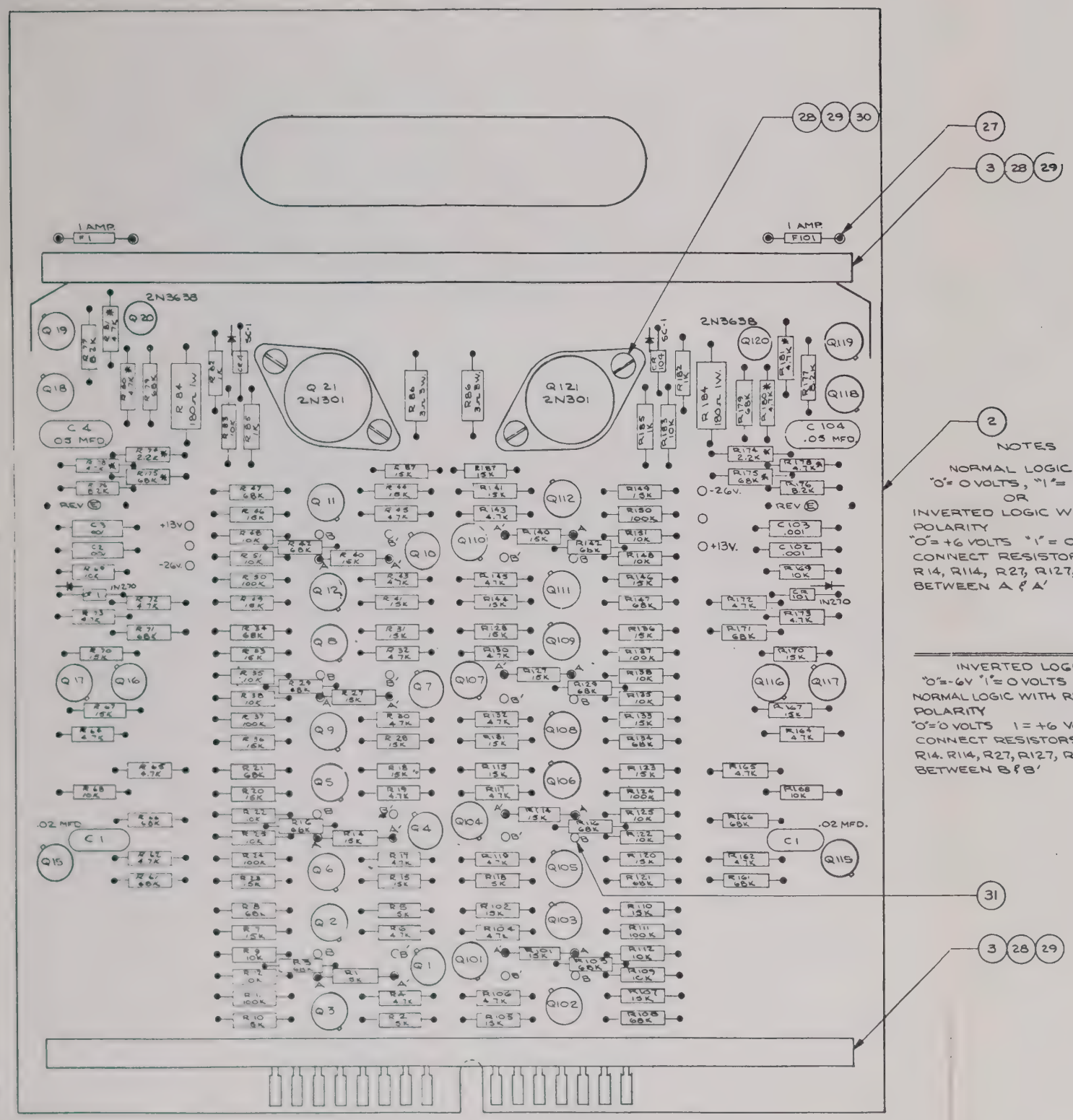
NORMAL LOGIC
"0" = 0 VOLTS, "1" = -6 VOLTS
OR
INVERTED LOGIC WITH REVERSED POLARITY
"0" = +6 VOLTS, "1" = 0 VOLTS
CONNECT RESISTORS R1, R101, R14, R114, R27, R127, R40, & R140 BETWEEN A & A'
FOR ZERO SUPPRESSION: CONNECT RESISTORS R13, R113, R26, R126, R39, R139, R52, & R152 BETWEEN B & B'

INVERTED LOGIC
"0" = -6 VOLTS, "1" = 0 VOLTS
OR
NORMAL LOGIC WITH REVERSED POLARITY
"0" = 0 VOLTS, "1" = +6 VOLTS
CONNECT RESISTORS R1, R101, R14, R114, R27, R127, R40, & R140 BETWEEN B & B'
FOR ZERO SUPPRESSION: CONNECT RESISTORS R13, R113, R26, R126, R39, R139, R52, & R152 BETWEEN A & A'

▲ -- TRANSISTORS ARE TYPE 2N404 UNLESS SPECIFIED
▲ -- RESISTORS ARE 1/2W, 10% UNLESS SPECIFIED.

* = 5% RESISTORS
R 74, 75, 78, 80, 81 AND R 174, 175, 178, 180, 181 ARE 5%

FIGURE 6-1
H2 SCHEMATIC



	QTY REQD	ITEM	DWG SIZE	PART NO.	DESCRIPTION	MATERIAL	MATL SPEC	SYM
(D)	2	34			RESISTOR 2.2K ½W 5%	1		
*	2	33			RESISTOR 68K ½W 5%	1		
(D) *	6	32			RESISTOR 4.7K ½W 5%	1		
	38	31		S6084	FUNNEL EYELETS	5		
	4	30			HEX NUTS 4-40			
	12	29			I.T.L.W. #4			
	12	28			B.H.M.S. 4-40 x 5/16 LG.			
(J)	4	27		NS-430-25	FUSE MTG. RIVET	6		
	2	26			FUSE 1AMP	4		
		25						
	2	24			↑ SC-1			
(E)	4	23			DIODE 1N270			
		22			↑			
	2	21			↑ 2N301			
	2	20			↑ 2N3638			
	34	19			TRANSISTOR 2N404			
	2	18		1DP-1-203	↑ .02 MFD.-100V.-10%	3		
	2	17		1DP-2-503	↑ .05 MFD.-100V.-10%	3		
	4	16		WMF1D1E	↑ CAPACITOR .001 MFD.-100V.-10%	2		
		15						
		14						
	2	13			↑ 3Ω - 3W - 10%	↑		
	2	12			↑ 180Ω - 1W - 10%			
(C)	4	11			↑ 82K - ½W - 10%			
	8	10			↑ 100K - ½W - 10%			
	22	9			↑ 10K - ½W - 10%			
	4	8			↑ 1K - ½W - 10%			
	24	7			↑ 68K - ½W - 10%			
	26	6			↑ 4.7K - ½W - 10%			
	46	5			RESISTOR 15K - ½W - 10%	1		
		4						
	2	3	A	8093	STIFFENER			
	1	2	J	8256	BOARD			
	–	1	D	8257	"H2" BOARD ASSY.			E

FIGURE 6-2
H2 ASSEMBLY

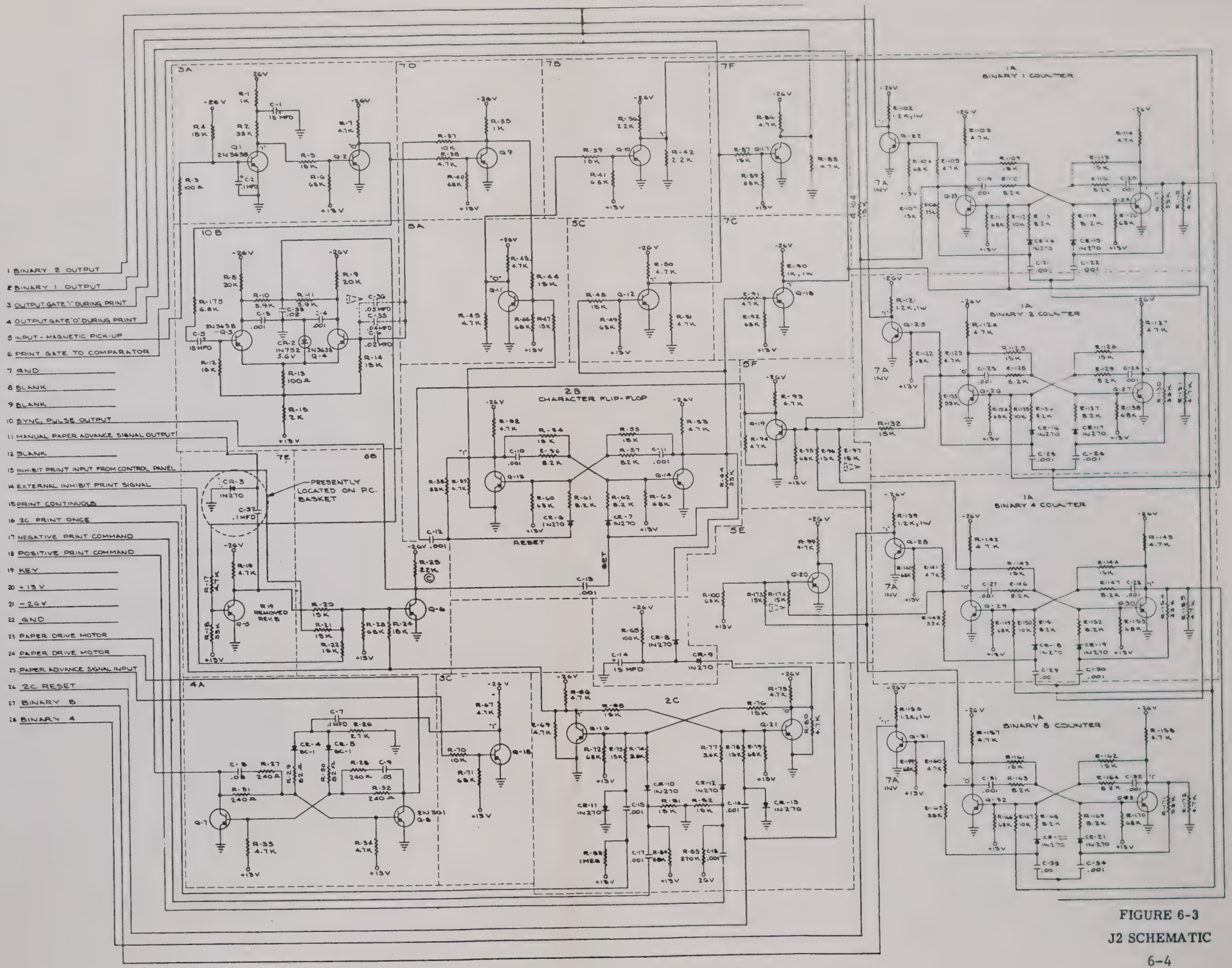
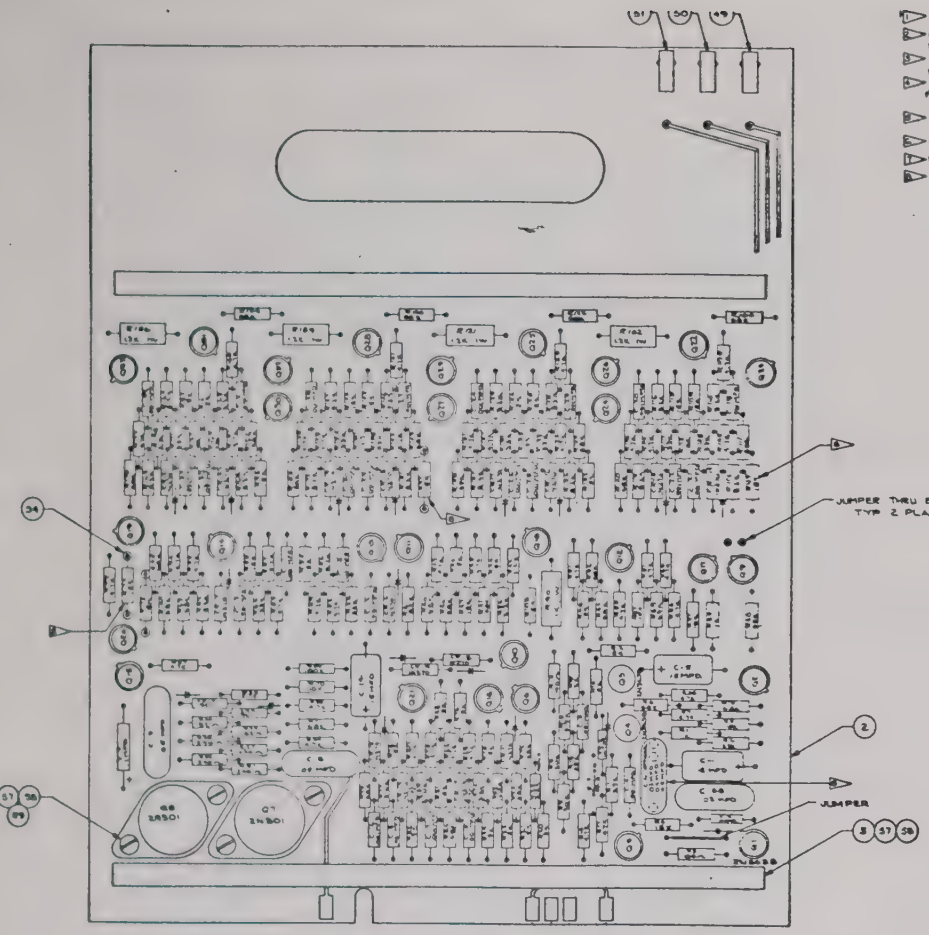


FIGURE 6-3
J2 SCHEMATIC



1. MFR. : ALLEN-BRADLEY OR EQUIV
2. MFR. : CDE. OR PHYSICAL/ELECTRICAL EQUIV.
3. MFR. : ARCO - "ELMENCO" OR PHYSICAL / ELECTRICAL EQUIV
4. MFR. SPRAGUE - "TANTALUM" OR PHYSICAL / ELECTRICAL EQUIV. MFRS CALLOUT NUMBER : 150D104X0035A2-PB.
5. MFR. : CDE. OR PHYSICAL/ELECTRICAL EQUIV.
6. MFR. : AMERICAN PANCOR INC.
7. MFR. : UNITED SHOE
8. SEE CHART ON SHEET 2

REVISIONS				
LTR		DESCRIPTION	DATE	APPROVED
A	4	PER ECA 9	8-67	
B	5	PER ECA 9744		
C	6	AS PER ECA 9198		
D	7	AS PER ECA 11198	7-68	

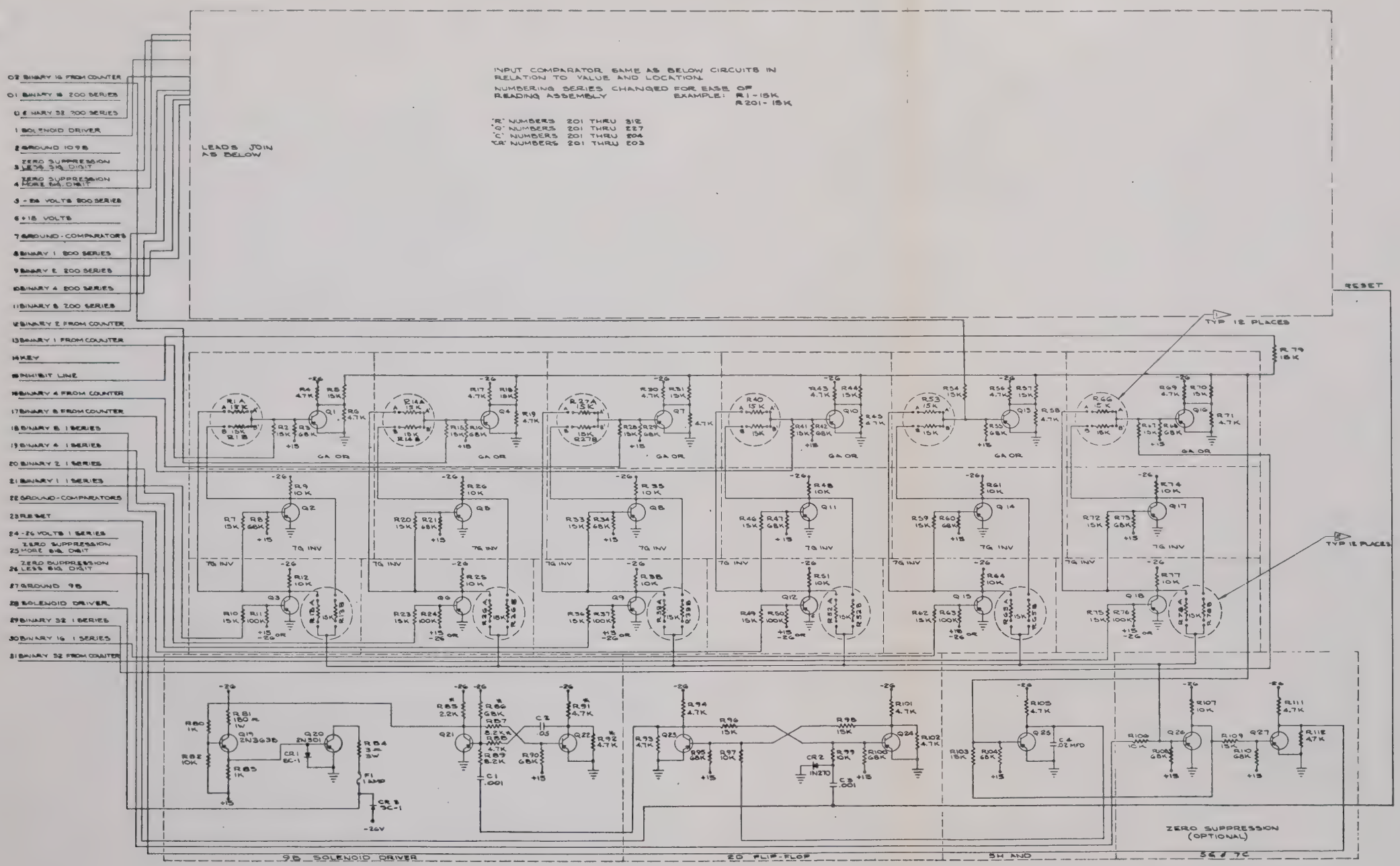
REFERENCE CHART COVERING THE INPUT CONNECTIONS FOR THE '3E' & '5E' AND GATES AND THE PROPER CAPACITOR TO USE IN THE '10B' CIRCUIT WHEN CHANGING PRINT DRUMS AND PRINTING SPEEDS

DRUM TYPE	PRINT SPEED	'10B' CIRCUIT CAPACITOR	'3E' R174	'5E' R97 / R107
BB	25 LPS	C-36 .05 MFD	DELETE	DELETE
BB	30 "	C-35 .04 "	"	"
GC	30 "	C-6 .02 "	ADD	ADD
GB	20 "	C-6 .02 "	"	"

	30				
	29				
1	28			1MEG	
1	27			270K	
1	26			100K	
EB	25			68K	
	24				
12	23			33K	
	22				
2	21			20K	
38	20			15K	
6	9			10K	
20	8			82K	
1	7			68K	
C B 40	6			47K	
2	3			39K	
2	4			36K	
1	3			27K	
C 3	2			22K	
1				2K 2W	
4	10			12K 1W	
1	9			1K 1W	
2	8			1K	
4	7			240Ω	
2	6			100Ω	
2	5			RESISTOR 82Ω 2W, 10%	
	4			"	
2	3	1	8093	STIFFENER	
1	2	1	8265	BOARD	
-	1	3	8280	J-2 BOARD ASS'Y	D

	60					
4	59			HEX NUT 4-40		
12	58			FLAT FIBER WASHER #4		
12	57			B.H.M.S. 4-40 x 5/16 LG		
	56					
	55			"		
18	54		5G084	FUNNEL EYELET	△	
	53			"		
	52					
1	51		2-582119-9			
1	50		2-582119-5		△	
1	49		2-582119-2	TEST PROBE RECEPTACLE		
	48					
	47					
3	46			2N3638		
2	45			2N301		
EB	44			TRANSISTOR 2N404		
29	43			" INSULATORS		
	42					
2	41			SC-1		
1	40			IN752		
16	39			DIODE IN270		
	38					
	37					
2	36	△		.1MFD .33V, 20%	△	
3	33		NLW-15 25	15 MFD, 25V	△	
2	34		1DP-1-203	.02 MFD	△	
1	33		1DP-1-403	.04 MFD	△	
3	32		1DP-2-503	.05 MFD	△	
26	31		WMF101E	CAPACITOR .001 MFD, 100V, 02	△	

FIGURE 6-4
J2 ASSEMBLY


INPUT COMPARATOR SAME AS BELOW CIRCUITS IN RELATION TO VALUE AND LOCATION.
NUMBERING SERIES CHANGED FOR EASE OF READING ASSEMBLY
EXAMPLE: R1 - 15K
R201 - 15K
'R' NUMBERS 201 THRU 312
'Q' NUMBERS 201 THRU 237
'C' NUMBERS 201 THRU 204
'CR' NUMBERS 201 THRU 203
LEADS JOIN AS BELOW
02 BINARY 16 FROM COUNTER
01 BINARY 8 200 SERIES
0 E HARY 32 200 SERIES
1 SOLENOID DRIVER
2 GROUND 109B
3 ZERO SUPPRESSION LESS SIG. DIGIT
4 ZERO SUPPRESSION MORE SIG. DIGIT
5 -26 VOLTS 800 SERIES
6 +15 VOLTS
7 GROUND - COMPARATORS
8 BINARY 1 800 SERIES
9 BINARY E 200 SERIES
10 BINARY 4 800 SERIES
11 BINARY 8 200 SERIES
12 BINARY 2 FROM COUNTER
13 BINARY 1 FROM COUNTER
14 KEY
15 INHIBIT LINE
16 BINARY 4 FROM COUNTER
17 BINARY 8 FROM COUNTER
18 BINARY 8 1 SERIES
19 BINARY 4 1 SERIES
20 BINARY 2 1 SERIES
21 BINARY 1 1 SERIES
22 GROUND - COMPARATORS
23 RESET
24 -26 VOLTS 1 SERIES
25 ZERO SUPPRESSION MORE SIG. DIGIT
26 ZERO SUPPRESSION LESS SIG. DIGIT
27 GROUND 9B
28 SOLENOID DRIVER
29 BINARY 32 1 SERIES
30 BINARY 16 1 SERIES
31 BINARY 32 FROM COUNTER
RESET
TYP 12 PLACES
TYP 12 PLACES
GA OR
TG INV
ZERO SUPPRESSION (OPTIONAL)
9B SOLENOID DRIVER
ED FLIP-FLOP
5H AND
56 & 7C

'R' NUMBERS 1 THRU 112
'Q' NUMBERS 1 THRU 37
'C' NUMBERS 1 THRU 4
'CR' NUMBERS 1 THRU 2

CAUTION
H-3 PRINTED CIRCUIT CARD CONTAINS COMPLETE CIRCUITRY FOR TWO INDIVIDUAL PRINT COLUMNS. FOR BREVITY ON THIS SCHEMATIC ONLY CIRCUITRY FOR ONE PRINT COLUMN IS SHOWN

NOTE

NORMAL LOGIC
'0' = 0 VOLTS, '1' = 3 VOLTS
OR
INVERTED LOGIC WITH REVERSED POLARITY
0' = 3 VOLTS, '1' = 0 VOLTS

> CONNECT RESISTORS R1, R201, R14, R214, R27, R227, R40, R240, R53, R253, R66 & R266 BETWEEN A'S

> FOR ZERO SUPPRESSION: CONNECT RESISTORS R13, R213, R26, R226, R39, R239, R52, R252, R65, R265, R78 & R278 BETWEEN B'S

INVERTED LOGIC
'0' = -3 VOLTS, '1' = 0 VOLTS
NORMAL LOGIC WITH REVERSED POLARITY
'0' = 0 VOLTS, '1' = 3 VOLTS

> CONNECT RESISTORS R1, R201, R14, R214, R27, R227, R40, R240, R53, R253, R66 & R266 BETWEEN B'S

> FOR ZERO SUPPRESSION: CONNECT RESISTORS R13, R213, R26, R226, R39, R239, R52, R252, R65, R265, R78 & R278 BETWEEN A

ALL TRANSISTORS ARE TYPE 2N404 UNLESS SPECIFIED

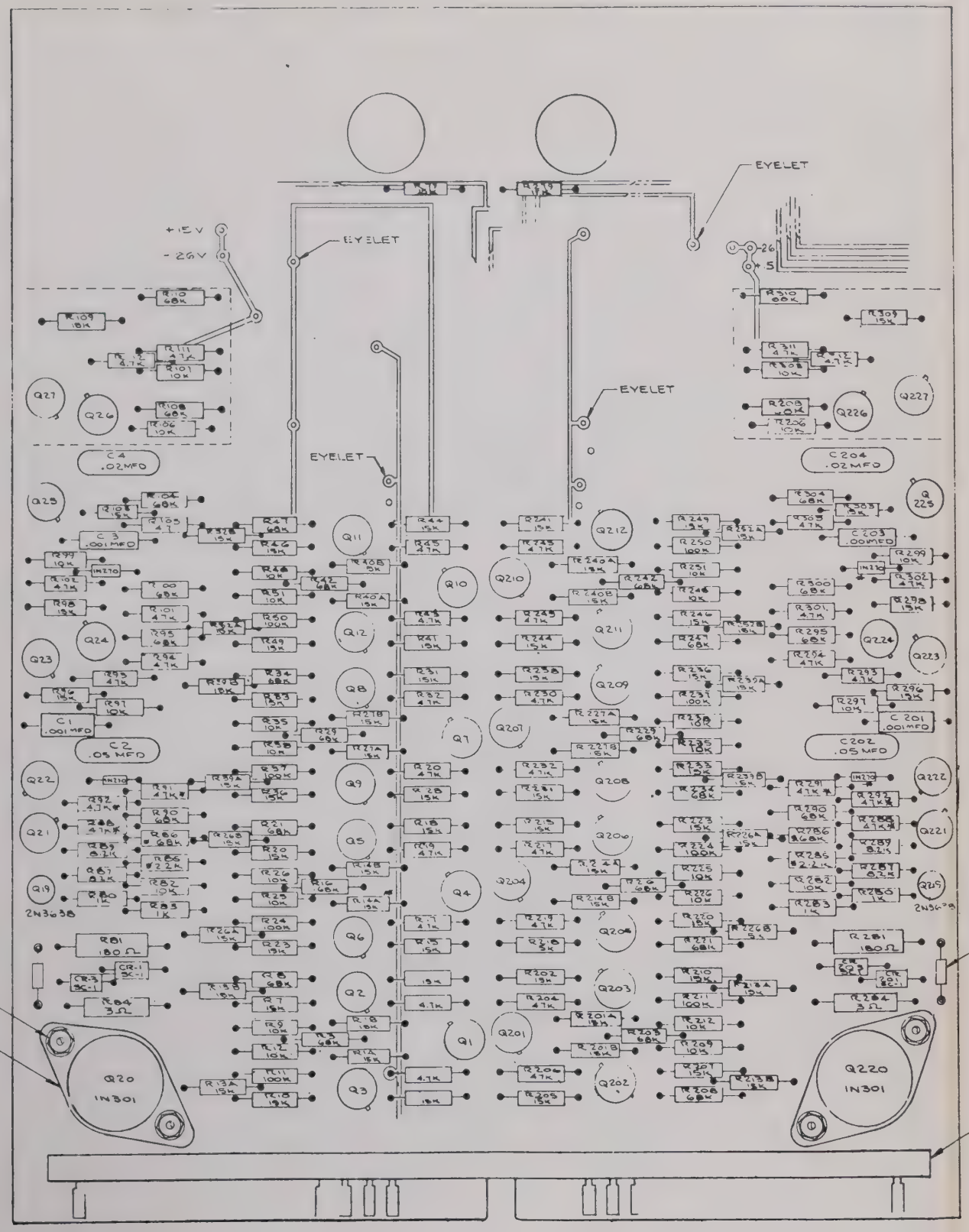
ALL RESISTORS ARE ½W, 10% UNLESS SPECIFIED

* = 5% RESISTORS
R80, R86, R88, R91, R92 AND R285, R284, R286, R291, R292 ARE 5%

> C1200 & 1600 PRINTERS FOR 4 WIRE INPUT
TRANSISTORS Q13, Q14, Q15, Q16, Q17, Q18, Q213, Q214, Q215, Q216, Q217, Q218 AND RELATED COMPONENTS ARE NOT REQUIRED

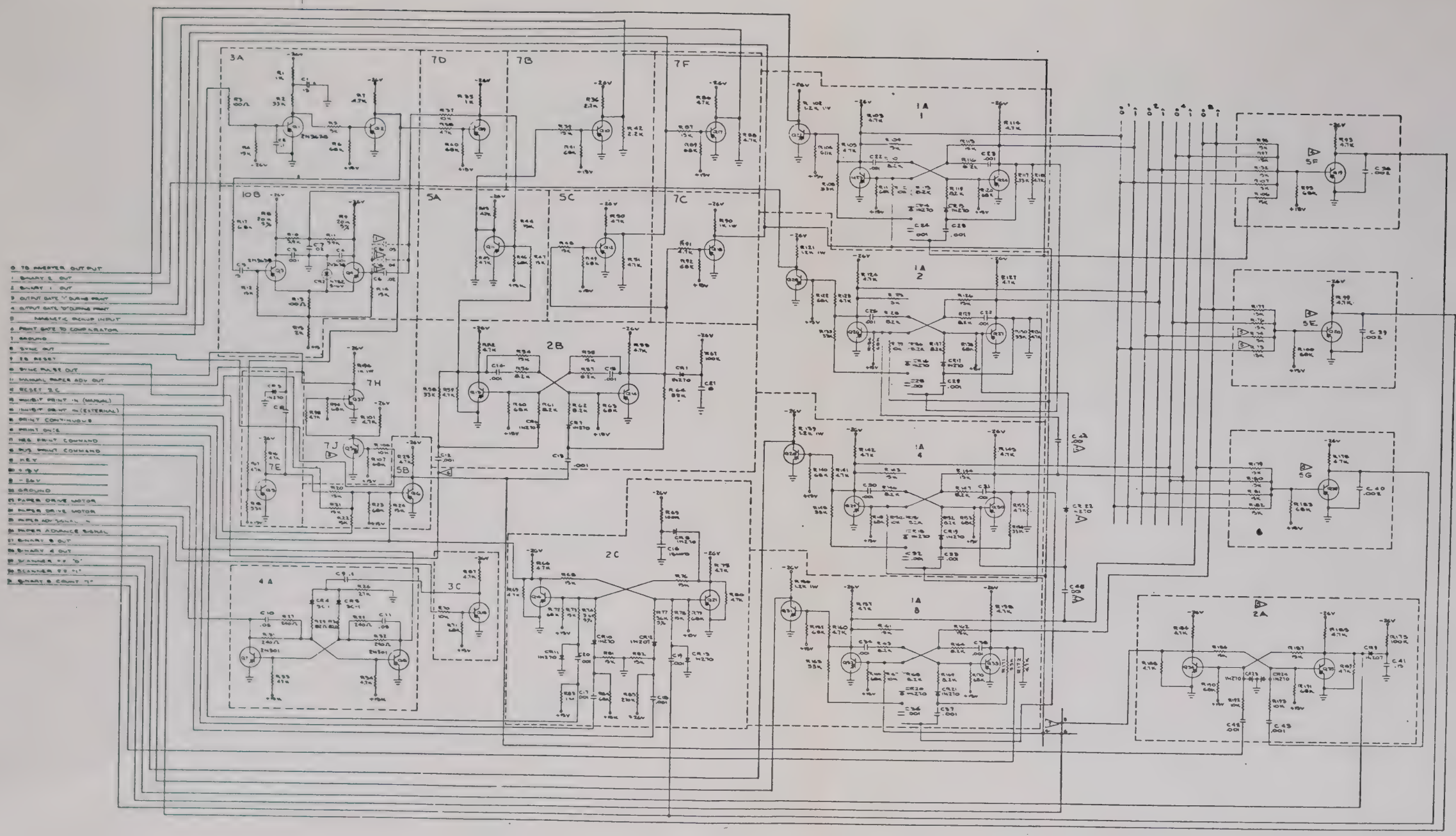
2200 PRINTER FOR ALPHA NUMERIC
TRANSISTORS Q13, Q14, Q15, Q16, Q17, Q18, Q213, Q214, Q215, Q216, Q217, Q218 AND RELATED COMPONENTS ARE REQUIRED.

FIGURE 6-5
H3 SCHEMATIC
6-6



	40				
4	39			WASHER FLAT	#4 CAD. PL.
4	38			WASHER FIBER	#4
8	37			WASHER ITL	#4 CAD. PL
4	36			HEXNUT	4-40 CAD. PL.
8	35			SCREW BHMS	4-40 X 5/16 LG CAD. PL.
	34				
2	33			MICA INSULATOR 2N301	
40	32			INSULATOR 2N404	
2	31			* 2N3638	
38	30			2N404	
2	29			TRANSISTOR 2N301	
	28				
4	27			* .001 MFD	CDE WME 101E
2	26			.02 MFD	" " 1DP-1-203
2	25			CAPACITOR .05 MFD	ARCO ELMENCO 1DP-2-503
	24				
4	23			SC-1	
4	22			DIODE 1N270	
	21				
2	20			* 3Ω	3W 10%
2	19			68K	↑ ↑
6	18			4.7K	
2	17			22K	1/2W 5%
2	16			180Ω	1W
8	15			100K	↑
28	14			68K	
58	13			15K	
26	12			10K	
4	11			82K	
30	10			↑ 4.7K	↑ ↑
4	9			RESISTOR 1K	1/2W 10%
	8				
	7				
2	6			FUSE 27600 -PICO	LITTLE FUSE 1 AMP
4	5			FUSE HOLDER	NUGENT EX-740-PS
124	4			EYELETS (FUNNEL)	UNITED SHOE 3-6084
1	3	A	3-8093	BOARD, STIFFINER	
1	2	J	3-8303	H3 ART WORK	
	1	D	3-7971	ASSY H3 BD	

FIGURE 6-6
H3 ASSEMBLY



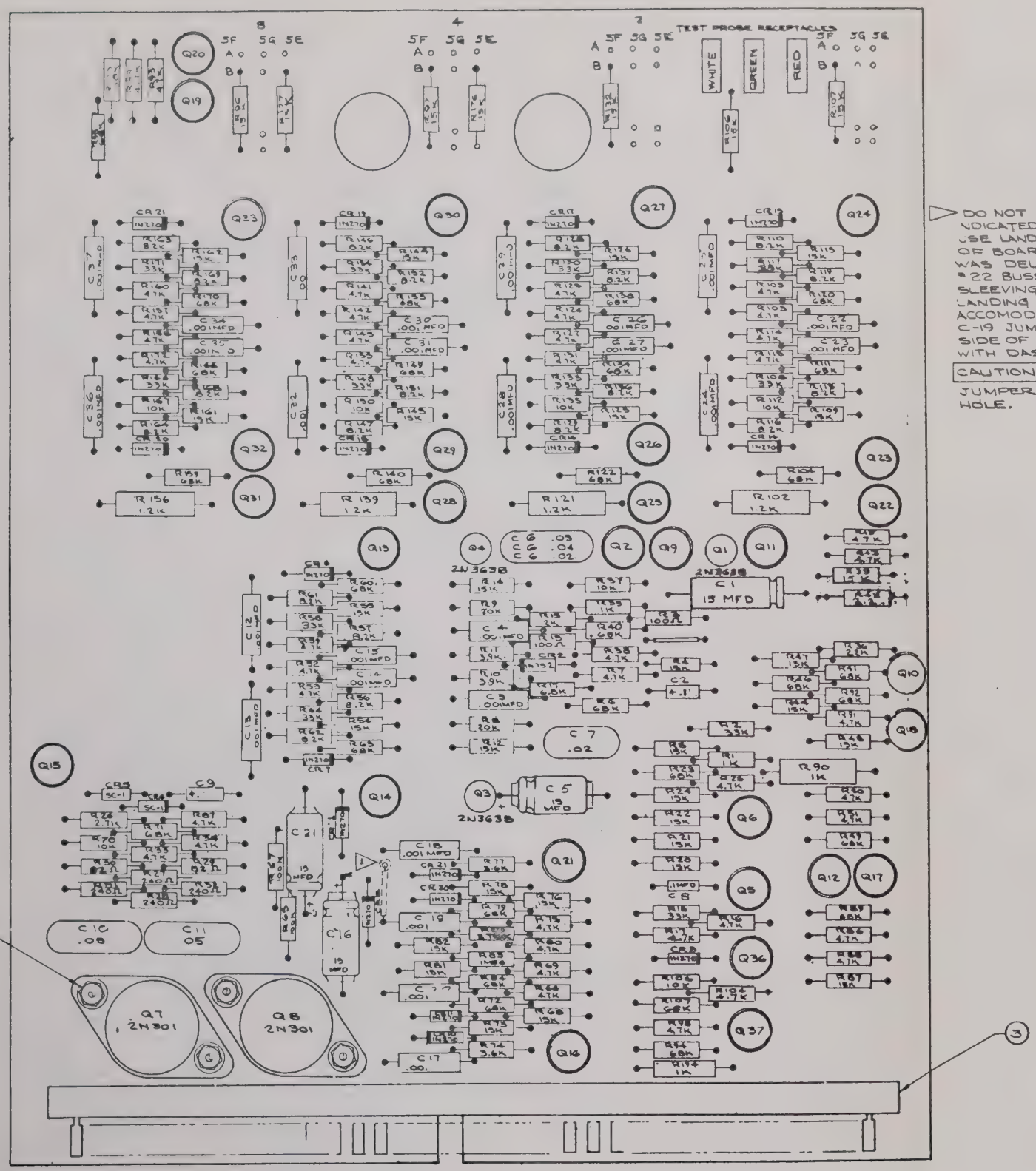
NOTES

1. ALL CAPACITORS ARE IN MFD FOR DO UNLESS SPECIFIED
2. ALL RESISTORS ARE 1/8W 10% UNLESS SPECIFIED
3. ALL TRANSISTORS ARE 2N404 UNLESS SPECIFIED
4. LAST R NO. = 196
5. LAST Q NO. = 38
6. LAST CR NO. = 34
7. LAST C NO. = 45

DRUM TYPE	PRINT SHIELD	10KC INPUT CIRCUIT
8B	20 LPS	C8 = .05 MFD
6B	20 LPS	C6 = .01 MFD
6C	30 LPS	C6 = .01 MFD

1. BINARY COUNTER DYNAMIC COMPONENTS C39, C40 AND C41 ARE USED FOR DERIVATION AS INDICATED ON THIS DRAWING.
2. MODEL 2300 ONLY. IF PRINTER IS DESIGNED FOR ASYNCHRONOUS MODE J7 IS NOT USED
3. MODEL 2300 ONLY. IF PRINTER IS ALPHANUMERIC CIRCUITS BRANDS 36 ARE NOT USED
4. MODEL C1300 ONLY. PC CARD J3 CIRCUITS E4 AND 5 ALSO RESISTORS R173 AND 9 ARE NOT USED
5. MODEL C1300 & 1400. RESET CAPACITOR C42 OF CIRCUIT 19 TIED TO THE COLLECTOR OF TRANSISTOR Q19 OF CIRCUIT REF. ASSY DWG D-8386
6. MODEL 2300 ONLY. PC CARD J3 WILL NORMALLY HAVE AN EYELET AT 4 AND 8 TO COMPLETE CIRCUIT CONTINUITY WITH NO EYELET AT 6. AN EYELET IN 8 AND 6 IN NO EYELET IN 4 MAY BE USED IN SPECIAL CIRCUITRY WHEN COUNTS ARE PERMUTED

FIGURE 6-7
J3 SCHEMATI

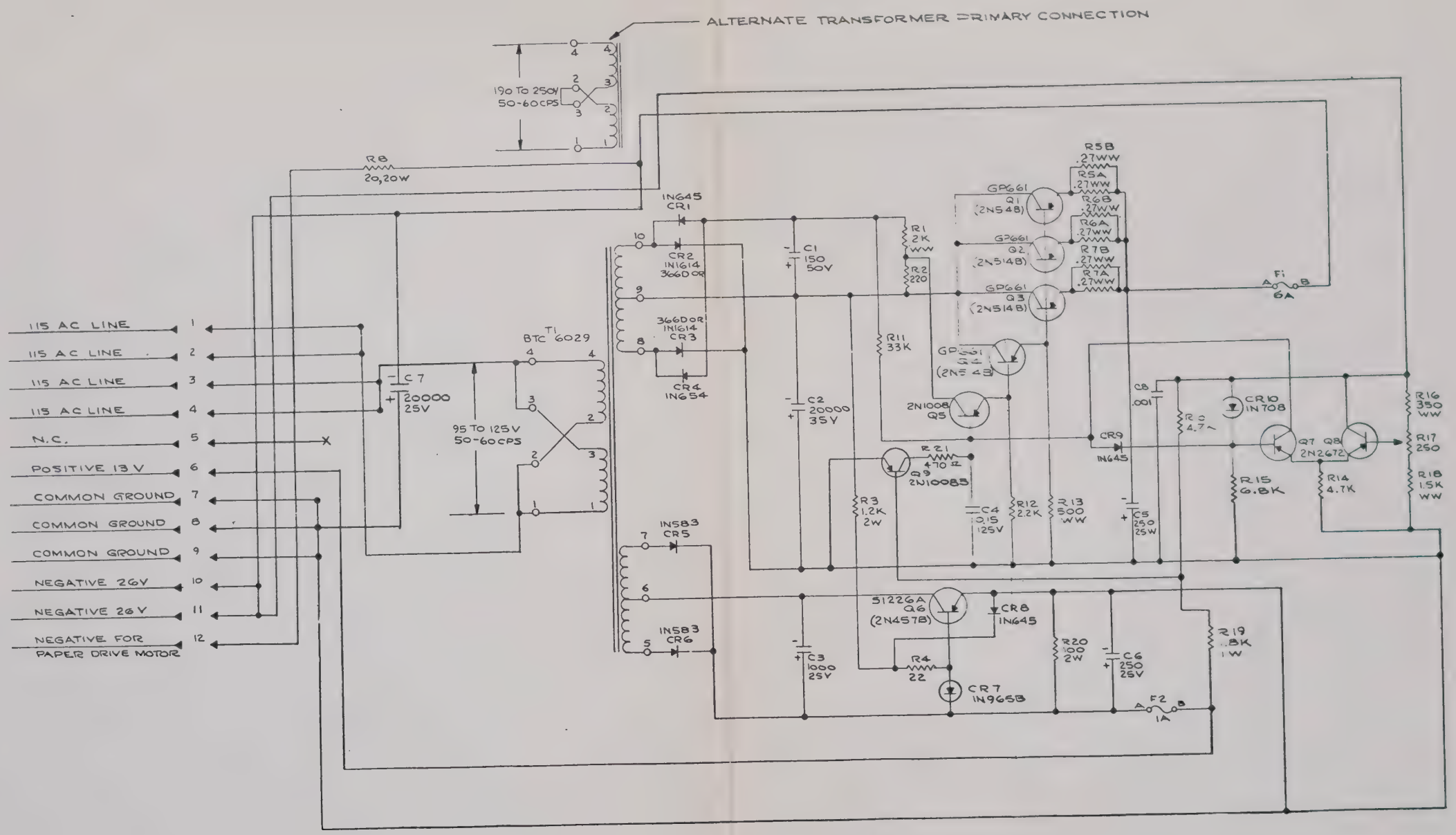


DO NOT INSERT EYELET INDICATED IN POS " ON SHOWN USE LANDING ON COPPER SIDE OF BOARD WHERE EYELET WAS DELETED AND CONNECT #22 BUSS AND TEFLON SLEEVING BETWEEN THIS LANDING AND THE LANDING ACCOMODATING CAPACITOR C-19 JUMPER S ON COPPER SIDE OF BOARD AS SHOWN WITH DASH LINE ON DWG

CAUTION DO NOT FEED JUMPER WIRE THRU EYELET HOLE.

QTY REQD	ITEM	DWG SIZE	PART NO.	DESCRIPTION	MATERIAL	MATL SPEC	SYM
4	45			WASHER FIBER			
4	44			WASHER FLAT			#4 CAD PL
8	43			WASHER ITL			#4 CAD PL
4	42			HEX NUT			4-40 CAD PL
8	41			SCREW BHMS			4-40 x 5/16 LG CAD PL
1	40			IN752			
17	39			IN270			
2	38			DIODE SC-1			
4	37			15 MFD			
3	36			.1 MFD			
2	35			.02 MFD			
3	34			.05 MFD			
26	33			CAPACITOR .001 MFD			
1	32			270 K			
4	31			240 Ω			
2	30			100 Ω			
2	29			82 Ω			
2	28			100 K			
1	27			1 MEG			
30	26			68 K			
	25			33 K			1/2W 10%
2	24			20 K			1/2W 5%
33	23			15 K			
7	22			10 K			
20	21			8.2 K			
1	20			6.8 K			
41	19			4.7 K			
2	18			3.9 K			1/2 W 10%
2	17			3.6 K			1/2 W 5%
	16						
1	15			2.7 K			
2	14			2.2 K			
1	13			2 K			
8	12			1 K			1/2 W 10%
2	11			1 K			1 W 10%
4	10			RESISTOR 1.2 K			1 W 10%
33	9			TRANSISTOR INSULATORS			
3	8			TRANSISTOR 2N3638			
2	7			TRANSISTOR 2N301			
30	6			TRANSISTOR 2N404			
3	5			TEST PROBE RECEPTACLES	AMP		
AR	4			EYELETS (FUNNEL)	UNITED SHOE 36084		
1	3	A	8093	BOARD STIFFENER			
	2	J	8312	J3 ARTWORK			
1	1	D	8386	J3 BOARD ASSY			

FIGURE 6-8
J3 ASSEMBLY



NOTES —
UNLESS OTHERWISE NOTED
RESISTANCE VALUES ARE IN OHMS ±10% ½W
CAPACITANCE VALUES ARE IN MICROFARADS

FIGURE 6-9
POWER SUPPLY SCHEMATIC,
1200 & 1600 PRINTER

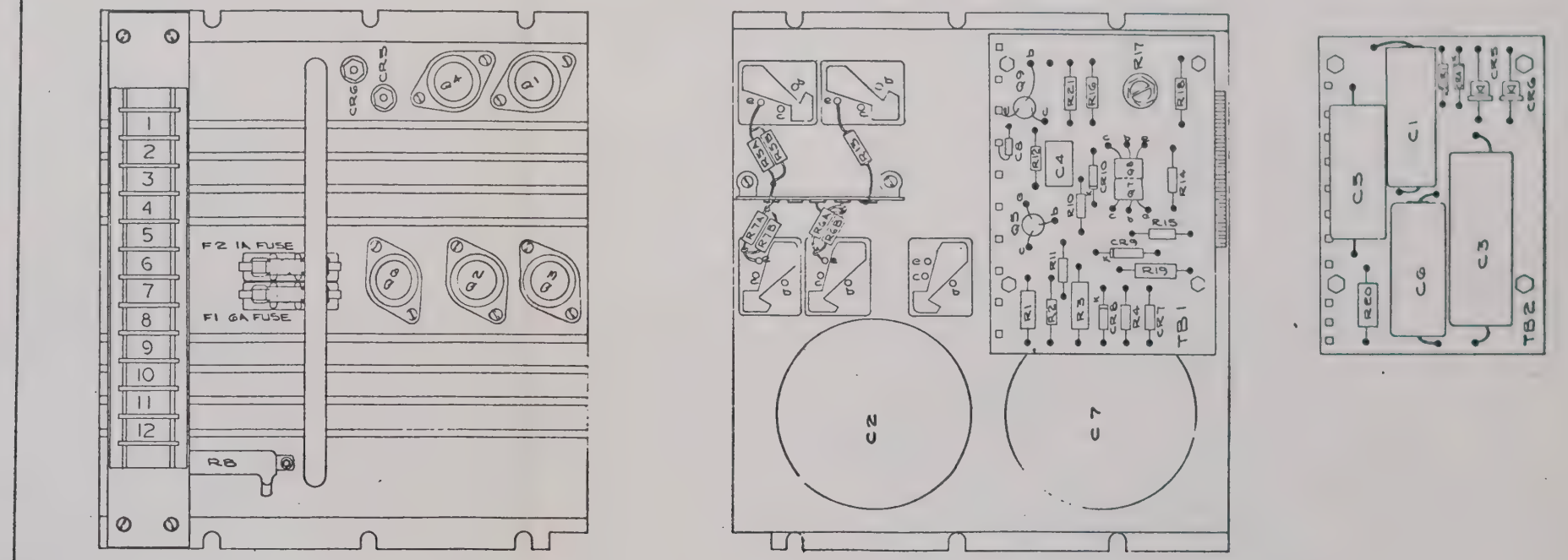
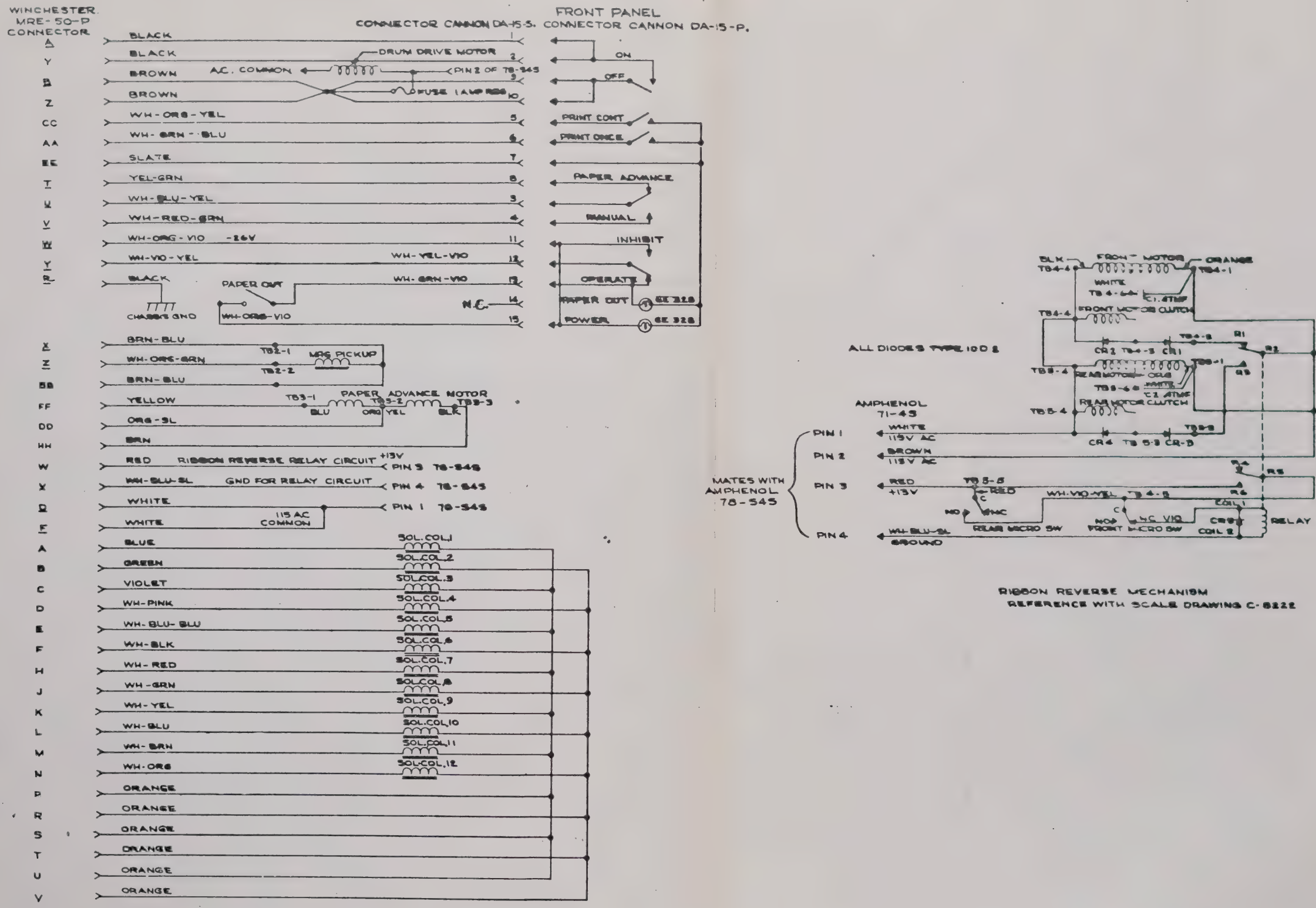
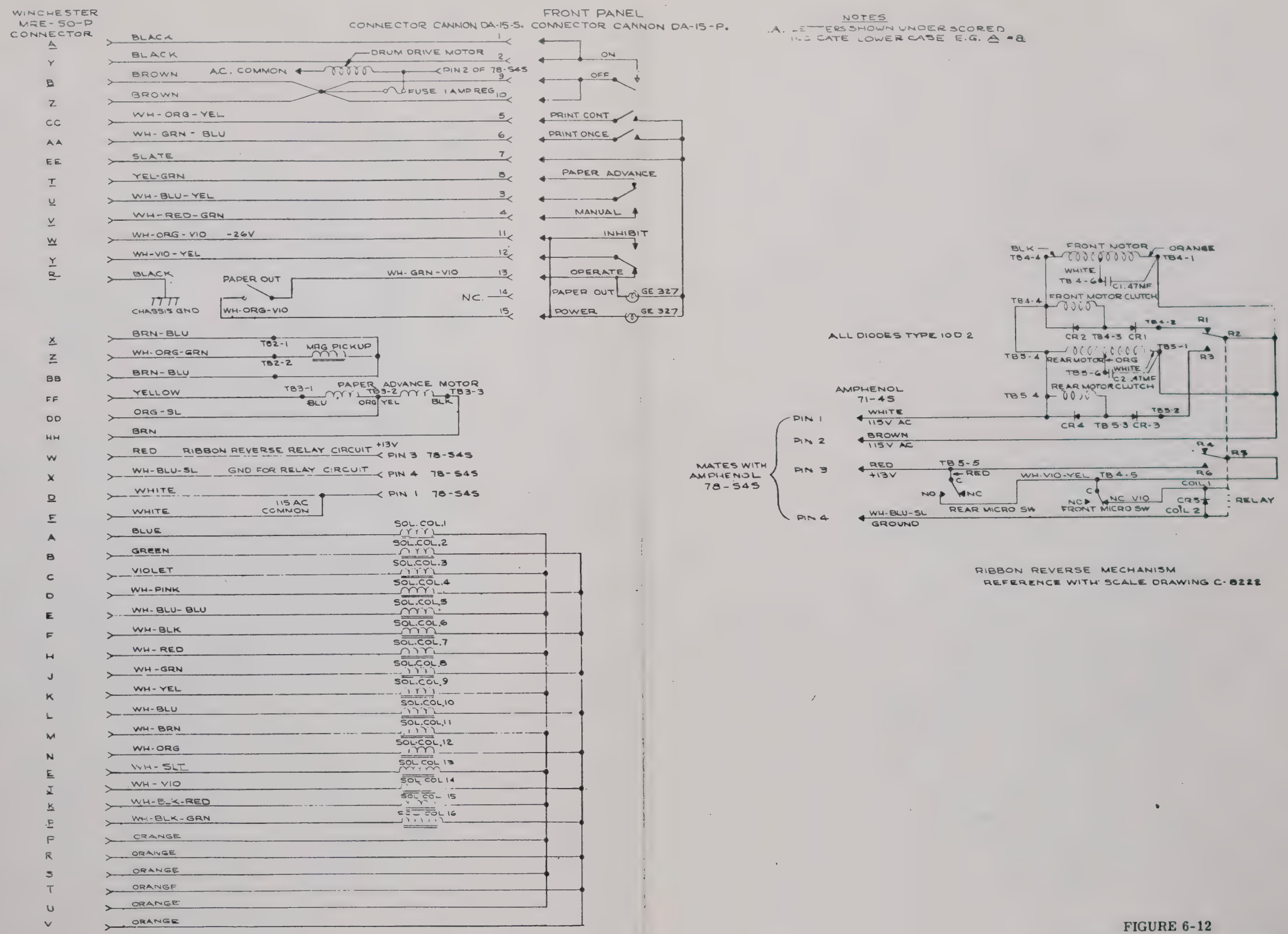


FIGURE 6-10
POWER SUPPLY ASSEMBLY,
1200 & 1600 PRINTER



RIBBON REVERSE MECHANISM
REFERENCE WITH SCALE DRAWING C-8222

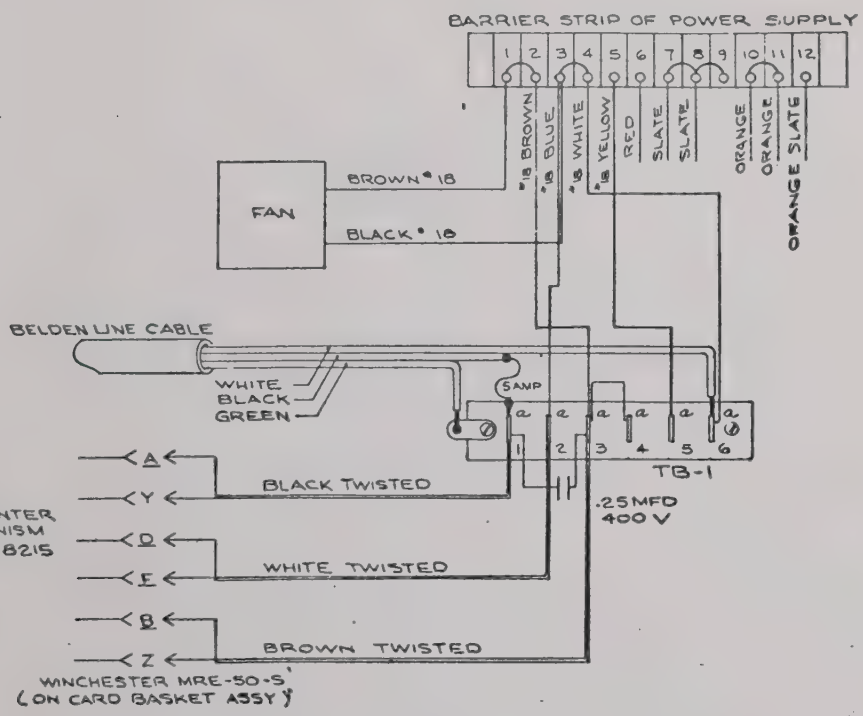
FIGURE 6-11
MECHANISM & RIBBON REVERSE,
SCHEMATIC, 1200 PRINTER



RIBBON REVERSE MECHANISM
REFERENCE WITH SCALE DRAWING C-8228

FIGURE 6-12
MECHANISM & RIBBON REVERSE,
SCHEMATIC, 1600 PRINTER

PRIMARY WIRING 115 VOLTS AC



PRIMARY WIRING 220 VOLTS AC

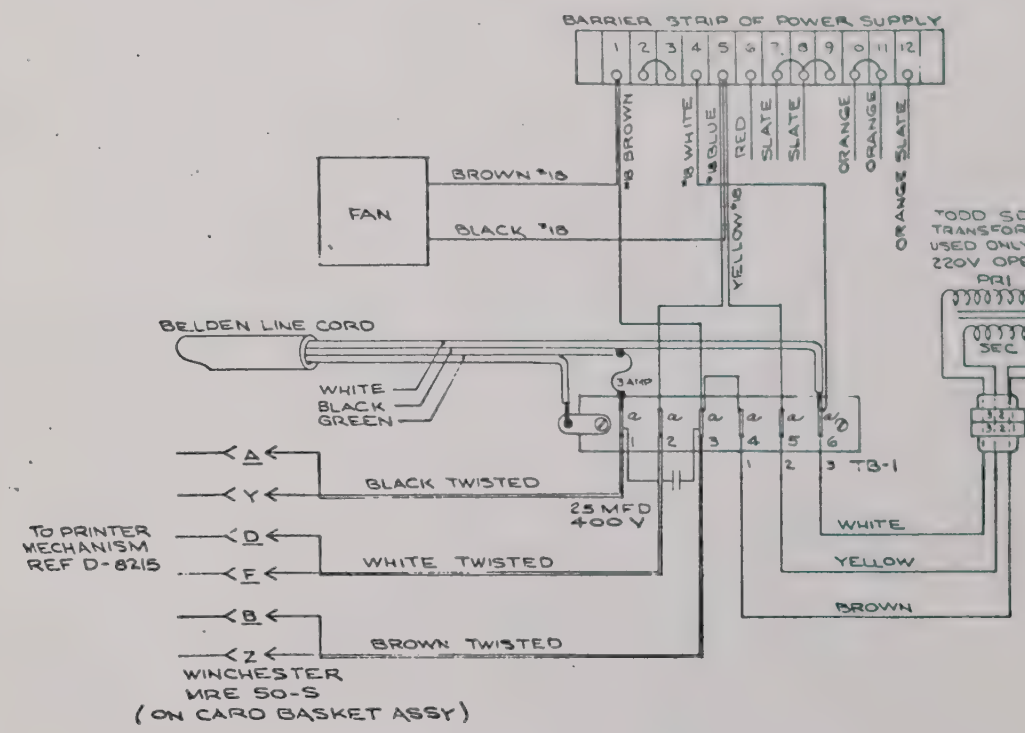


FIGURE 6-13
PRIMARY WIRING, 115V & 220 VAC
1200 & 1600 PRINTER

SECTION 7
SPARE PARTS AND WARRANTY

7.1 INTRODUCTION. Spare parts for the MDS Printer are listed alphabetically in Table 7-1, and printer supplies are listed in Table 7-2.

TABLE 7-1: SPARE PARTS

Item	Description	Used On Printer Series		Manufacturer	Part No.
		1200	1600		
1.	*Actuator, Microswitch, Ribbon Reverse	x	x	Minneapolis Honeywell	JS246
2.	Bearings				
2.1	Bearing Assembly, Print Drum	x	x	MDS	8246
2.2	Bearing, Delrin, Ribbon Reverse	x	x	MDS	8298
3.	Belts				
3.1	*Belt, Drive Motor, STD. Printer	x	x	Morse	150XL025
3.2	*Belt, Drive Motor, Action Paper Printer	x	x	Morse	140XL025
4	*Bulb, Front Panel Indicator Lights	x	x	G.E.	327
5.	Cable Assy, Printer Mechanism	x	x	MDS	8157
6.	Cover, Dust	x	x	MDS	8094
7.	Fasteners				
7.1	Fastener, Mechanism, R.H	x	x	South Co.	48-10-101-10
7.2	Fastener, Mechanism, L.H.	x	x	South Co.	48-20-101-10
8.	*Feet, Printer Bench Mount	x	x	Atlantic India	18
9.	Fuses				
9.1	*Fuse, Line, 115VA 50/60 Hz	x	x	Commercial	3AG-5AMP
9.2	*Fuse, Line230VAC 50/60 Hz	x	x	Commercial	3AG-3AMP
9.3	*Fuse, Power Supply, +15VDC	x	x	Commercial	3AG-1AMP
9.4	*Fuse, Power Supply, -26VDC,STD Printer	x	x	Commercial	3AG-6AMP
9.5	*Fuse, Power Supply,-26VDC, 40LPS only		x	Commercial	3AG-10AMP
9.6	*Fuse, Printer Mechanism	x	x	Commercial	3AG-1AMP
9.7	*Fuse,Solenoid Driver,Pico 1 amp	x	x	Little Fuse Co.	276001
10.	Hammer, Print	x	x	MDS	7067
11	Knob Assy, Paper Roll	x	x	MDS	8275
12.	Motors				

*Recommended Spare Part

RIBBON, SILK 7440-R71-9834

TABLE 7-1: SPARE PARTS (Cont'd)

Item	Description	Used on Printer Series 1200	Used on Printer Series 1600	Manufacturer	Part No.
12.1	*Motor, Drum Drive, 50/60 Hz (8200)	x	x	Genrl. Ind.	A-10-CW
12.2	*Motor, Drum Drive, 400 Hz	x	x	Globe	83A603
12.3	*Motor, Fan Drive, 60 Hz (2163)	x	x	Alliance	JS0601-60
12.4	*Motor, Fan Drive, 50 Hz	x	x	Alliance	JS0601-50
12.5	*Motor, Fan Drive, 400 Hz	x	x	Rotron	3B400Z3
12.6	*Motor, Ribbon Reverse, 60Hz (8132) 6105-00-X44-6296	x	x	Hurst	ARDA-10RPM-60
12.7	*Motor, Ribbon Reverse,50Hz (8198)	x	x	Hurst	ARDA-10RPM-50
12.8	*Motor, Stepping, Paper	x	x	Sigma	9AG-4E2-98610
13.	Pickup, Magnetic	x	x	MDS	7113
14.	Print Drums				
14.1	Print Drum, 12 col; See Table 1-5	x		MDS	Specify
14.2	Print Drum, 16 col; See Table 1-5		x	MDS	Specify
15.	*Power Supply	x	x	MDS	8385
16.	Printed Circuit Cards				
16.1	*Printed Circuit Card,Type H3	x	x	MDS	8303
16.2	*Printed Circuit Card,Type J3	x	x	MDS	8312
16.3	*Printed Circuit Card Extender for Type H3	x	x	MDS	8326
16.4	*Printed Circuit Card Extender for Type J3	x	x	MDS	8327
17.	*Rake Assembly, Paper	x	x	MDS	8116
18.	*Relay, Ribbon Reverse	x	x	Clare	A384330
19.	Retainer, Ribbon Spool	x	x	MDS	8145
20	Shims				
20.1	*Shim, Anti-Smear, Paper	x		MDS	8037
20.2	*Shim, Anti-Smear, Paper		x	MDS	8357
20.3	*Shim, Paper Out, Action Paper	x	x	MDS	8272
21	Solenoid Assy, Print Hammer	x	x	MDS	7454
22.	Spring, Paper Accumulator	x	x	MDS	8053
23.	Switches				
23.1	*Switch, (Microswitch) Paper Out	x	x	Minneapolis Honeywell	11SM1
23.2	*Switch, (Microswitch) Ribbon Reverse	x	x	Minneapolis Honeywell	11SM1

*Recommended Spare Part

TABLE 7-1: SPARE PARTS

Item	Description	Used On Printer Series		Manufacturer	Part No.
		1200	1600		
23.3	*Switch, Panel, Control, Two Position	x	x	Carling	TILB-6A-IL
23.4	*Switch, Panel, Control, Spring				
24.	Tear-Off Bar	x	x	MDS	8179
25.	Wheels				
25.1	*Wheel, Drive, Paper Advance 20 LPS	X	X	MDS	8136
25.2	*Wheel, Drive, Paper Advance 30-40 LPS	x	x	MDS	7136
25.3	*Wheel, Idler, Paper Advance	x	x	MDS	8064

*Recommended Spares

TABLE 7-2: PRINTER SUPPLIES

Item	Description	Used On Printer Series		Manufacturer	Part No.
		1200	1600		
100.	Connector				
100.1	Connector, Input Plug & Hood	x		Winchester	MRE75P, JTCH-1,
100.2	Connector, Input Plug & Hood		x	Winchester	MRE104P, MRA104H-1
101.	Container, Shipping, Printer	x	x	MDS	--
102.	Filters				
102.1	**Filter, Air	x	x	MDS	8134
102.2	Filter, R.F.I.	x	x	Filtron Co.	LSP223
103.	**Manual,1200/1600 Series Digital Strip Printers	x	x	MDS	M-1507-70
104.	Paper				
104.1	**Paper,Action (Roll only), 24/CTN	x	x	MDS	3-8445
104.2	**Paper, Fan-Fold Package 24/CTN	x	x	MDS	8028
104.3	**Paper, Roll, 24/CTN.	x	x	MDS	8027
105.	Ribbons				
105.1	**Ribbon, Silk	x	MD	MDS	8346
105.2	**Ribbon, Silk		x	MDS	8354

**Recommended Spares

Date Due

ME-5734

MDS

AUTHOR

1200-1600 HIGH SPEED DIGITAL

TITLE

PRINTERS

DATE DUE	BORROWER'S NAME	DATE RETURNED

BRODART Printed in U.S.A.